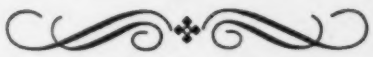
PROCEEDINGS

FOURTEENTH ANNUAL MEETING

NORTH CENTRAL WEED CONTROL CONFERENCE

DECEMBER 10-12, 1957



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Proceedings

Fourteenth Annual Meeting

of the

North Central Weed Control Conference

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Preface

The Proceedings of the Fourteenth Annual meeting of the North Central Weed Control Conference is a record of the papers and reports presented at the 1957 Conference in Des Moines, Iowa December 10-12. Copies of this Proceedings are available at $2.00 per copy from Dwight W. Lambert, Secretary-Treasurer, North Central Weed Control Conference, Inc., P. O. Box 104, State Capitol, Lincoln, Nebraska. A Research Report published by the North Central Weed Control Conference, is also available at $2.00 per copy from the same address.

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OPENING REMARKS

F. W. Slife[1]

It is a real pleasure for me to have the opportunity of welcoming you to the 14th annual meeting of the North Central Weed Control Conference.

The field of weed control has made a rather phenomental growth over the past 57 years and even more pronounced in the last 12 years. About 1900, selective herbicidal actions were discovered and brought into use in several selective herbicides. Shortly after 1900, the arsenicals came into being and received considerable attention as soil sterilants. About 1925 sodium chlorate was first used for weed control and in the 1930's the dinitro phenols were developed as selective herbicides. Each of these developments brought forth a new interest in weed control. Shortly after 1940, 2,4-D was discovered and shortly after that the low volume sprayer was originated. Since the introduction of 2,4-D, many new materials have been introduced and some of these have found a place in our weed control program. With each new development, more interest in weed control has been kindled and there continues to be a growing awareness of the weed problem.

In 1900, I assume that you could count on both hands the number of people who were actively working in the field of weed control, both in state and Federal experiment stations. A recent list of workers complied by the USDA indicates that there are now approximately 100 people working in the weed field at the state or Federal level. This does not include the many regulatory people on the state and county level or the people in industry who are continually searching for new and better chemical compounds. This means that our field of weeds is gaining stature and is receiving much more attention than at any time previously. In addition to having 4 strong regional conferences, we now have a good national organization with a publication that has gained wide acceptance.

With all of these achievements, it would appear that we could sit back and relax. But I am sure you would agree with me that the contrary is true. The answering of a few problems we have thus far achieved has only brought on 10 more problems for every one solved. The more that we learn about the field of weeds and their control, the more we want to know. I believe we are entering a new era in weed control. We are now devoting more time on trying to find out how herbicides work. We are beginning to study weed ecology and the life history of weeds. Fundamental studies are beginning to replace much of the general testing programs that once took so much of our time. Our graduate training programs are getting stronger and we can now offer to industry and institutions highly trained men in the field of weeds.

Our North Central Weed Control Conference was organized with the purpose of bringing together the people in research, extension, regulatory, and the chemical companies to exchange ideas and to pool their efforts. I am sure that the objective has not changed —we are still a coordinated team. The chemical industry has been particularly cooperative in this Conference and I hope we can keep their good will and cooperation as we move forward.

Our regulatory and extension people can look with pride at the use of herbicides and other good weed control practices that are being followed today. They deserve a great deal of credit for stimulating interest at the farmer level in good weed control programs. They perhaps deserve the most credit for increasing the number of farmer innovators or early adoptors of new practices. It seems to me we now have more farmers who realize the seriousness of our weed problem and are willing to try new things just as soon as they are developed. Our regulatory and extension people can not relax on the job because of the tremendous need for education on the farmer level. We still have too many farmers who add 3 pints of 2,4-D to a barrel of water without any knowledge of how much 2,4-D per acre he is applying.

I think that all segments of our Conference can look with pride at the achievements in our field but we must look to the future and continue our steady advancement. I hope that the attendance at our North Central Conference is a measure of the respect we hold in our field. We've come a long way from the 90 people registered at our first Conference in 1944 to the approximately 650 registered at our last Conference in 1956.

It has been a real honor for me to serve as President of the Conference for this year and I would like to take this opportunity of thanking the people who have worked so willingly on committee assignments. No one has refused an assignment when asked and this makes the President's job pretty easy. I hope you enjoy the next few days as much as we have in preparing it for you.

[1] University of Illinois, Urbana, Illinois. President, NCWCC.

FUTURE CHEMICALS FOR WEED CONTROL

C. E. Minarik[1]

I was very happy to accept Lyle Dercheid's invitation to speak to the North Central Weed Control Conference because it has provided me with an opportunity to attend your very interesting sessions and to discuss problems of mutual interest with my many friends in the North Central Weed Conference. This I would not have been able to manage without an invitation to present a paper.

The first time that I was invited to speak at a North Central Weed Control Conference was in 1946 and by coincidence the meetings that year were also held in Des Moines. At that time I had just completed the task of converting the organization of the Detrick herbicide program from a military to a civilian basis. We had had a head start in the growth-regulator-herbicide field and were eagerly pushing ahead with a team of young, energetic investigators.

Today, however, I come to address you after I have just seen the last person who was engaged in this program safely transferred to another position. Members of our herbicide research group have transferred to industry, the U. S. Department of Agriculture and others have been absorbed into other Detrick activities. It has been very disheartening to disband an organization that you have spent 12 years in building.

The subject of new herbicides has been a favorite of mine ever since I started work in this field, and I am very happy to review for you briefly the latest offerings of the herbicide industry.

One of the more promising new herbicides is Geigy's Simazin which was first released for experimental use during 1956. Chemically Simazin is 2-chloro-4,6-bis-(ethylamino)-*s*-triazine. The technical material is a white crystalline substance which is insoluble in water and only slightly soluble in certain organic solvents. It is formulated as a 50% wettable powder and also as pellets containing 10% active ingredient. Simazin is most effective in pre-emergence applications. The fact that it is practically insoluble in water causes it to remain in the upper soil level, thereby affecting germinating weed seeds. The extremely low solubility is responsible for little or no lateral movement of Simazin in the soil. This is very important in selective weed control, especially in band treatments, and is also of importance in non-selective or general weed control, when treating roadsides, railroad beds and industrial

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sites which may be adjacent to cultivated land. The low solubility of triazine herbicides of this type adds significantly to their residual action.

When post-emergence applications of Simazin are made, it is necessary to use sufficient water to carry the material to the root zone since its effectiveness in controlling both broad leaf and grassy weeds is due to its action against the root system rather than contact action against the above-ground plant organs. In some cases, especially in non-selective or industrial weed control, it may be desirable to eliminate established weed growth by mowing, plowing or discing prior to applying Simazin for residual weed control. Since Simazin has little effect when applied to above ground portion of plants, there is little or no drift hazard when making Simazin applications.

Simazin was extensively tested throughout the country on a number of different crops at dosage rates ranging from ⅛ to 16 lb of active ingredient per acre. Results were most outstanding on corn, where 1 to 4 lb/A applied prior to weed emergence was sufficient to control weeds for the entire growing season. Tests on tomatoes and potatoes were also very promising at dosage rates of 1 and 2 lb/A of active ingredient. Of the crops on which Simazin has been tested thus far, corn, asparagus, potatoes and tomatoes are among the most tolerant.

In the field tests on sweet corn and field corn in the United States and Canada, pre-emergence applications of 1 to 4 lb/A resulted in excellent control of broadleaf and grassy weeds for practically the entire growing season. On sandy soils dosage rates lower than 1 lb gave good control. Corn is apparently extremely tolerant to Simazin as shown by the fact that applications were made at rates up to 16 lb/A with no apparent injury to the corn. In some cases, yields of corn from Simazin treated plots have been twice that from untreated plots. In addition, yields of Simazin treated corn plots have been significantly greater than yields of plots treated with standard herbicides now commercially available. In some cases, post-emergence applications of Simazin on corn, at the rate of 2-4 lb/A, have also resulted in excellent weed control.

Applications of Simazin at rates up to 3 lb/A have been made on tomatoes after transplanting without injury. Tests conducted on tomatoes growing in different types of soil in various sections of the country have been uniformly promising. When Simazin was applied at the rate of 6 lb/A in combination with herbicidal oil, excellent weed control was obtained with no injury to the crop.

In both pre-emergence and post-emergence applications, potatoes were tolerant of up to 2 lb/A of Simazin. Asparagus was also capable of withstanding up to 2 lb/A in a directed post-emergence spray on silt loam.

Wheat appears to be quite tolerant to Simazin. Pre-emergence sprays at dosages of 2 lb/A caused no injury to wheat on clay loams and 4 lb/A caused only slight injury. In post-emergence applications, 2 lb/A caused slight injury.

The following crops are injured by pre-emergence applications of 2 lb/A: barley, ladino and red clovers, soybeans, sudan grass, sugar beets, red beets, carrots, cauliflower, lettuce, mustard, onions, peas, and spinach.

Twenty-eight species of weeds were effectively controlled at dosage rates of 1 to 4 lb/A. In many cases the lower rate gave good control. A few of the susceptible weeds are barnyardgrass, carpet weed, crabgrass, dandelion, foxtail, ground cherry, knotweed, lambsquarters, nightshade, plantain, purslane, quackgrass, ragweed, redroot pigweed, shepherd's purse, water hemp, wild buckwheat, wild mustard, wild oats, and witchgrass.

As a result of the limited research work reported, Geigy states that Simazin appears most promising for control of weeds in corn and recommends further studies on such crops as asparagus, grapes, sugar cane, tomatoes, potatoes, ornamentals, wheat, clover, cauliflower and fruit trees.

For industrial and general weed control, Simazin at rates of 5 to 10 lb/A appears very promising on industrial sites, in paths, along railroads, power lines and other areas where complete control of vegetation is desired. The lower rate will control most annual broadleaf and grassy weeds and some susceptible perennials for about one year. Higher rates are suggested for longer residual action and for control of resistant perennials.

To kill existing weed growth, it is important that sufficient water be used to carry the Simazin to the soil at the base of the weeds. Best results are obtained by removing existing weeds by mowing, plowing, or other means before applying Simazin for residual control.

Tests conducted thus far indicate that Simazin remains active in the soil for approximately 6 months when applied at the rate of 2 lb/A.

Hexachloroacetone is a herbicidal material developed by General Chemical Division of Allied Chemical and Dye Corporation as compound GC 1106. This material appears to have some promise as a fortifier for weed oils when used to selectively spray scattered infestations of grass in crop land and for general non-selective weed control in non-crop areas. Rea, Norris, and Wiese have worked with this material in Texas since 1953 for controlling Johnsongrass in cotton and in non-crop areas. Repeated treatment of 6-inch Johnsongrass sprouts with 3 gallons of HCA per 100 gallons of oil, kills tops promptly and during rainy portions of the growing season causes deterioration of the rootstocks twice as fast as similar treatments with oil alone. Three treatments with HCA in oil at intervals of 10 to 14 days early in the spring usually eradicate Johnsongrass, whereas 4 to 6 treatments ordinarily are required for oil used alone. Sub-lethal effects of HCA cause distortion, twisting and stunting of the leaves and stems of the grass and inhibit growth of rootstocks. Foliage applications of HCA in oil were less successful than crown treatments.

Many oils will kill tender stems of Johnsongrass any time during the growing season, but they are most effective in exhausting rootstocks early in the spring before a new crop of these storage organs is produced. Such oils seldom have delayed or residual effects. Adding HCA to an oil gives a systemic effect to the spray and increases its contact toxicity slightly.

The following oils were satisfactory carriers of HCA: Varsol-1 (naptha), kerosene, diesel fuel oil, Sovaspray 100 and mixtures of these oils. Varsol-1 or mixtures containing 50% Varsol-1 were superior to the other carriers tested.

Varsol-1 fortified with HCA was more effective for crown treatment of established Johnsongrass than Varsol-1 alone, regardless of weather. The effects of the HCA in the oil were more pronounced and impressive following rains of 1 inch or more. The sooner such rains occurred after the initial treatment the fewer the applications required to eradicate the grass. One crown treatment with 3 gallons of 90% HCA per 100 gallons of Varsol-1 sometimes eradicated the grass when rain of 1 inch or more occurred within 2 weeks after treatment. However, 3 crown treatments in the spring usually were required to eradicate the grass. Six treatments sometimes were required in the summer when rain failed to occur during the treatment period.

Thoroughly wetting the crowns of short grass and the crowns and lower 12 inches of the stems of tall grass (including the seed stage) with 3 gallons of 90% HCA per 100 gallons of Varsol-1 in the fall reduced stands of Johnsongrass 95% or more by the following spring. The over-winter effects of fall treatments with HCA in oil were not contingent on the age of the grass treated, on obtaining top kill with the oil, or on leaving the grass undisturbed after treatment.

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Spring, summer and fall applications of HCA in oil to clumps of Johnsongrass in cotton had no observable effects on the next crop of cotton. Fall applications of such sprays stunted and distorted sorghum planted in the treated spots the following spring. Similar effects should be expected on other grass crops planted during early spring.

HCA can be used in such non-crop areas as railroads, pipelines, drainage ditches, fence rows, farm building areas and industrial areas. It can be applied any time during the growing season, but best results will be obtained when there is enough soil moisture for good growth or when first application is followed by about 1 inch or more of rain within 2 weeks. Spraying should be started early in the season when weeds are about 6 inches high. One or more follow-up spot treatments may be needed for deep-rooted perennials and heavy tufted grasses. Second application should be made when weeds are 8-10 inches high. The spray should be applied with enough pressure to wet the weeds completely, the volume used being dependent on the height and denseness of the weeds.

General Chemical's Urox Weed Killer is another newcomer for use as a soil sterilant in non-crop areas. It is made up of two good soil sterilants combined into a single molecule, 3(p-chlorophenyl)-1,1-dimethylurea and trichloroacetate. This material is absorbed by roots, primarily, and is therefore applied to the soil. It is applied as a dry granular material containing 22% of active ingredient.

Time of application is important, since results are affected by rainfall and plant reaction is much more rapid when plants are growing rapidly.

The manufacturer states that Urox is more effective than similar dosages of monuron alone.

Another new herbicide composed of a mixture of 3 standard herbicides is Chipman's Chlorea. It is composed of 40% sodium chlorate, 57% sodium metaborate and 1.25% 3(p-chlorophenyl)-1,1-dimethylurea. It is a non-selective soil sterilant type herbicide for the control of both broadleaf and grassy vegetation in industrial areas, along fence rows, around farm buildings, etc. It can be applied as a dry powder, liquid spray or as granules. For annuals or shallow-rooted plants 1 to 2 lb/100 sq ft is recommended; for perennials or deep-rooted plants 2 to 3 lb/100 sq ft.

Still another herbicide mixture containing monuron is National Aluminate's H-174. This herbicide contains 83% sodium tetraborate and 8% 3(p-chlorophenyl)-1,1-dimethyl urea. It also is non-selective and is primarily for soil sterilization in industrial areas, along fence lines, etc.

The use of Telvar W or CMU (monuron) as a spray requires better than average mixing equipment and large quantities of water. In order to take advantage of the excellent weed control properties of CMU but to get away from the large water requirement National Aluminate has formulated a mixture of these two herbicides in a dust-free dry granulated powder.

Results to date show clearly that H-174 gives superior weed control results over comparable applications of either of its two components. It is more persistent than either one, it is less vulnerable to adsorption by high clay or high carbon soils and it is less vulnerable to leaching. Dosage rates are 200 to 400 lb/A and a single application is effective for a year or longer.

Although amino triazole has been on the market now for several years, it is considered a new herbicide since it is still undergoing evaluation by many investigators and appears to be very promising. The American Chemical Paint Company has prepared an excellent progress report on this herbicide and I shall quote liberally from it.

Amino triazole is a white crystalline solid readily soluble in water. It is applied as an aqueous spray to the foliage of weeds. It is rapidly translocated to apical meristems where it interferes with chlorophyll synthesis and soon results in death of the meristems and eventually the entire plant.

Amino triazole appears to be very effective against Canada thistle. Dosage rates of 4 lb/A or higher have frequently produced 80 to 100% control the same season or the following spring. By fall of the second season, however, the degree of control drops sharply, indicating that treatment in successive years may be advisable to keep remnants from re-establishing a stand. Application times varying from rosette to early bloom stage or treatment of regrowth after mowing, yield essentially the same excellent results. In a single instance where the fields had been spring plowed and treated during the spring and early summer, control was not as good as when fields were not spring plowed. Plowing treated thistles two weeks after treatment did not appear to reduce amino triazole's effectiveness but poor results were reported from Minnesota when tillage followed 7 to 10 days after treatment.

Combinations of amino triazole with 2,4-D, CMU or 2,3,6-trichlorobenzoic acid decreased its activity. MCP did not enhance it significantly.

Other broadleaf weeds that are susceptible to amino triazole are bur ragweed, blueweed, horsetail, horse nettle, hoary alyssum, hemp nettle, milkweed, Russian ragweed, scentless chamomile, scentless mayweed, ragweed, pigweed, fanweed, prickly lettuce and false flax, to mention only a few.

Toadflax, wild buckwheat, yucca, and Russian knapweed are among those weeds resistant to the usual dosages.

Excellent control of top growth of nutgrass and moderate control of tubers were reported but nutgrass appears to require repeated treatments and cultivation for satisfactory control. Combination of amino triazole with 2,4-D or with dalapon increased nutgrass control. Cotton planted in an area plowed 11 days after treatment with amino triazole showed no injury at the 5 or 10 lb/A rates but 50% of the nutgrass was controlled. Fifteen lb/A controlled 70% of the nutgrass but reduced the cotton stand 50%.

On quackgrass amino triazole at rates up to 8 lb/A gave excellent control in the relatively dry years of 1954 and 1955, but only fair results in the relatively wet year 1956.

In Idaho, amino triazole applications made after a rain were more effective than those made before. Under semiarid conditions in Wyoming 8 lb/A of amino triazole gave 100% kill of quackgrass without disking. However, disking two weeks later greatly increased the effectiveness of applications at lower rates.

Combinations of amino triazole with dalapon or TCA increased the effectiveness of the latter herbicides as quackgrass killers.

Satisfactory control of bromegrass, 98%, resulted from 8 lb/A of amino triazole. Two and 4 lb/A gave 54 and 85% control, respectively. Amino triazole was not satisfacory for selective control. The 8 lb/A dosage rate reduced Kentucky bluegrass 70%.

A combination of 2 lb of 2,4-D and ½ lb of amino triazole or 2 lb of amino triazole alone gave 70% or better control of giant foxtail. Over 75% control of green and yellow foxtail was obtained by 4, 8 and 12 lb/A of amino triazole at lay-by when the grasses were 6 inches tall, and 8 to 12 lb/A at harvest time. In one instance 79% control was obtained with as little as 1 lb/A. Pre-emergence application of 6 lb/A produced no control but 25 to 30% control was obtained by 12 lb/A.

In Louisiana, Johnsongrass was controlled to the extent of 60 and 64% with 1 and 2 lb/A, respectively, of amino triazole. Experiments in other sections of the country with combinations of amino triazole and dalapon generally show no advantage over using either herbicide alone.

Pre-emergence treatment of wild oats with amino triazole was ineffective, but application at the milk stage

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produced 45% control with 5 lb/A and 93% control with 10 lb/A.

Control of carpetgrass and smut grass was reported with applications of 5, 10 and 15 lb/A, while 8 to 16 lb/A gave 60% control of torpedograss.

With respect to woody species, amino triazole appears to be highly specific for poison ivy and poison oak. Rates as low as 2 lb/A have given 100% kill. Thorough coverage is essential for optimum results, and application should be delayed until the leaves are fully expanded.

White ash stems 1 inch or less in diameter were killed by 5 lb/A. Kills of locust, red bud, elderberry, ash and scrub, red, black and chestnut oaks were obtained with 9 lb/A.

In Texas mulefat was completely killed but mistletoe showed no immediate significant response.

In Pennsylvania, at the 2 lb/A rate used for poison ivy control, dogwood, sassafras, oak and spicebush were unaffected. Even 9 lb/A did not have an apparent effect on dogwood, elderberry, spicebush, sassafras or aspen. Sixteen lb/A did not affect a good sized American elm supporting poison ivy which was sprayed with amino triazole.

On aquatic weeds amino triazole shows excellent results, particularly in controlling cattails. The addition of a wetting agent or surfactant seems to enhance the activity. Water sedge *(Carex aquatilis)* and burreed *(Sparganium americanum)* are both susceptible to this herbicide. *Phragmites* in relatively dry sites were controlled by 16 lb/A in the Mid-Atlantic states. In wet places a combination of 25 lb of dalapon and 8 lb of amino triazole applied during the flowering period produced good results. Applications of 500 ppm amino triazole were not effective on water milfoil, *Elodea*, or alligator weed.

Among resistant crop plants are cranberries, strawberries, gladiolus, cotton at 5 to 10 lb/A, and potatoes.

Pre-seeding applications of up to 8 lb/A followed by tillage in 2 to 4 weeks gave good weed control with no apparent injury to field or sweet corn, grain sorghum, wheat, beets, turnips, cucumbers, squash, pole beans or soybeans.

Two lb/A killed mowed alfalfa and severely injured red clover.

Dow's latest contribution to the herbicide field is 1,2,4,5-tetrachlorobenzene which has just been released for experimental purposes.

It is a solid material, practically insoluble in water and only slightly soluble in the usual organic solvents. It is formulated in a 50% granulated material with inert diluent or as a 20% material in a 16-20-0 ammonium phosphate fertilizer. The active ingredient is moderately toxic if taken internally and is somewhat irritating to the eyes or skin on prolonged contact.

1,2,4,5-Tetrachlorobenzene, at 5 to 15 lb/A, is highly specific for dormant or germinating wild oat seed. The dry herbicide which has been incorporated into the soil vaporizes into the soil atmosphere and diffuses to a limited extent. Apparently the vapors penetrate the seed coat and kill the embryo. This vapor activity on dormant seeds appears to be specific for wild oats and small grains.

It can also function as a root toxicant since certain other weeds are inhibited in growth if the chemical is still present in the soil at time of germination; however, it appears that seeds of species other than wild oats and cereals will not be killed by the vapors if they are still dormant. Stand reductions in pigweed, mustard and Russian thistle have been observed in field plots.

1,2,4,5-Tetrachlorobenzene is a volatile material and appreciable loss can result, particularly from a hot soil surface, if it is not worked into the soil soon after application.

Best results are obtained from applications to cool soil. September and October treatments in the Red River Valley gave essentially the same results as those applied the following May. Mid-summer treatments have been less successful presumably because of loss of chemical from the soil surface before incorporation or more rapid loss of vapor from warm soil after incorporation. Crops vary greatly in their tolerance for tetrachlorobenzene. Peas, soybeans, corn, potatoes, navy beans and sunflower appear to be quite tolerant; sugar beets, flax, and barley are intermediate in tolerance and wheat and oats are equally as susceptible as wild oats. Information on the tolerance of other crops is lacking.

Preliminary tests in the laboratory indicate that tetrachlorobenzene is not decomposed in soil by soil organisms. Since it is relatively insoluble in water, it may be assumed that it is lost from the soil primarily by volatilization. Field tests show that there may be sufficient residue from fall applications to adversely affect sensitive spring planted crops. Where susceptible crops are to follow treatment, it would seem desirable to use the material early in the fallow year to give it more time to dissipate. There has been no evidence of damage to plants sown one year after application.

Although 2,3,6-trichlorobenzoic acid was introduced as an experimental herbicide in 1954, recent results with this compound and mixtures of polychlorobenzoic acids appear very promising. The substituted benzoic acids are good temporary soil sterilants for controlling perennial weeds. Five to forty lb/A have controlled field bindweed, Russian knapweed, leafy spurge, cattails, horsenettle, halogeton, and white cockle. Crops such as soybeans, sorghum, red and alsike clovers, beans, and tomatoes are susceptible to low rates of the benzoic acids. Two to four lb/A gave 40-70% control of quackgrass with no injury to the corn and very satisfactory yield increases.

The polychlorobenzoics are proving to be valuable chemicals for brush control work. They kill many plants that are tolerant of 2,4-D and 2,4,5-T and their effects appear to be more persistent than those of the latter two compounds. Per acre costs of using polychlorobenzoics are expected to be comparable to present costs of using 2,4-D and 2,4,5-T.

Four to six lb/A killed balsam fir and black spruce. Eight and 16 lb/A killed sweet fern, hardhack, ground juniper, red cedar and white pine. Four lb/A killed horsetail, Mexican bamboo and Pennsylvania smartweed.

Stauffer's EPTC is another new herbicide worthy of mention. Chemically, it is ethyl-N,N-di-*n*-propythiolcarbamate. It is a clear liquid with an aromatic odor. It is slightly soluble in water but highly soluble in organic solvents. It is quite stable and non-corrosive.

EPTC is effective against grassy weeds when applied at any stage of germination or growth prior to emergence. Resistant crops can be safely treated at any stage of germination or growth (including established plants). Susceptible crops and weeds have shown no injury when treated any time after the early seedling stage.

EPTC has provided excellent weed control for the entire growing period of crops such as corn. Results to date have shown that this extended period of weed control is due to the downward movement of EPTC in soil rather than to an active concentration remaining on the soil surface.

Best results are obtained when volumes of 20 to 80 gal/A are used. Poor weed control was achieved with 10 gal/A or less. Soil moisture conditions at time of application have little effect other than to delay action when applications are to dry soils. Soil type and soil temperatures ranging from 60 to 102°F. do not influence herbicidal activity of EPTC.

The following is a partial list of crop plants resistant to 10 lb/A when applied pre-emergence; alfalfa, asparagus, red kidney bean, snap bean, birdsfoot trefoil, beets, cabbage, carrot, crimson, red and white clovers, field and sweet corn, eggplant, Korean lespedeza, onion, radish, soybean, tomato, and zinnia.

A list of weeds susceptible to 1 to 5 lb/A contains the following: Barnyard grass, bluegrass, crabgrass, crowfoot grass, Dallis grass, barley foxtail, bristly fox-

tail, green foxtail, giant foxtail, yellow foxtail, Johnsongrass, wild oats, sandspur, henbit, Jimson weed, lambsquarters, nodding spurge, and redroot pigweed. Five to ten lb/A will control chickweed, mustard, buckhorn plantain, prostrate pigweed, purslane, shepherdspurse and velvet leaf.

EPTC is one of the better herbicides to come on the market in recent years, and it should find wide use as a selective herbicide for pre-emergence applications.

The phenoxybutyric acids, more specifically 2,4-dichlorophenoxybutyric acid and 2-methyl-4-chlorophenoxybutyric acid, show promise for controlling certain broadleaf weeds in several legume crops and in cereals undersown with legumes. Dosage rates as high as 2 lb/A have not injured alfalfa, clover, oats, or wheat. Similar dosage of 2,4-D or MCPA causes severe injury to both the legume and the grain crops.

Broadleaf weeds in resistant varieties of peas have been controlled with 2 to 6 lb/A of 2,4-DB or MCPB, the latter herbicide being less injurious to the peas.

Soybeans, table and sugar beets, lettuce, spinach, and radishes are injured by 1 to 2 lb/A of 2,4-DB, lima beans, carrots and buckwheat have been variable, and celery, flax and corn are not injured by 1 to 2 lb/A of 2,4-DB.

Weeds susceptible to 2 lb/A or less are ball mustard, Canada thistle, cocklebur, creeping buttercup, curled dock, hemp nettle, hoary alyssum, *Kochia*, smartweed, lambsquarters, purslane, redroot pigweed, Russian pigweed, sowthistle and wild mustard. There are a number of others, such as Dow's dalapon; Rohm and Haas's FW450 for controlling crabgrass in turf; Monsanto's CDAA or Randox and CDEC or Vegedex for controlling weedy annual grasses and certain broadleaf weeds; American Smelting's cacodylic acid and monoethanolamine arsenite. But time does not permit me to discuss these very worthy herbicides in greater detail.

I have reviewed the more promising new herbicides that have been offered by the agricultural chemical industry. Now I would like to speculate on where future herbicides might come from and the nature of their chemical structure.

The phenoxy compounds have been examined by many investigators since the advent of 2,4-D and we have found specific uses for the phenoxybutyric acids, phenoxy ethyl sulfate and related compounds. It is quite possible that other side chains could yield additional compounds with desirable specificities.

Halogenated phenyl alkyl ethers have been reported by McLane *et al.* to show growth regulatory effects similar to those of 2,4-D. Mitchell and Marth have reported similar results for alpha methoxy phenylacetic acid. Neither group of compounds has been fully exploited for commercial use to my knowledge.

Modification of the substituents in the ring of phenoxy compounds should also yield derivatives of interest. MCP is our first example of this. The substitution of fluorine for chlorine in the ring should also improve the herbicidal characteristics for certain purposes. Weintraub has shown high activity in a leaf area repression test for certain fluorophenoxy derivatives. Anderson *et al.* have shown that fluorophenoxyacetic acids control annual bluegrass and crabgrass in fine turfs. The mixture of fluorine and chlorine in the ring also improves herbicidal properties. It was postulated at one time that compounds having high surface activity were better growth regulators than those with low activity. Incorporation of fluorine into the ring definitely increases surface activity. Additional scrutiny of phenoxy derivatives is certain to be profitable.

It has been known for many years that many compounds possessing an unsaturated ring structure and a side chain with a carboxyl group or a group convertible to a carboxyl possess growth regulatory properties. We have made use of the inhibitory properties of the phenoxy grouping but have not done much with other cyclic structures. While it is true that compounds containing indole and naphthalene rings have not proven to be useful herbicides, other ring structures have.

Amino triazole has a cylic structure although it does not possess the side chain. Maleic hydrazide is cyclic as is Alanap (N-1-naphthyl phthalamic acid). Another cylic structure worthy of study is the pyridoxy group. Substituted pyridoxyacetic acids show high activity of the 2,4-D type.

You will find that dozens of different cyclic compounds have been examined for curvature or cell elongation effects. Very few of these have been halogenated and tested for herbicidal properties. This area, in my estimation, is a very fertile one for study.

Other sources of compounds with biological activity are naturally occurring toxins produced by plant pathogenic fungi. Necrotic areas on plants infected by certain fungi are caused not only by competition between the fungus and host for nutrients, water, etc. but also result from the secretion of toxins by the pathogen. Characterization of such toxins and preparation of suitable derivatives should yield compounds of interest.

The earliest work in this country (1946 to 1950) on gibberellins (unfortunately unpublished; Detrick work) was done with this objective in mind. I realize that the gibberellins are not herbicides but associated with them is a toxic material that causes death of rice seedlings rather than cell elongation.

Another source of potential herbicides is from other plants. James Bonner and Reed Gray isolated a material toxic to plant growth from the leaves of *Encelia farinosa*.

Many other plants excrete materials from their roots into the soil that adversely affect growth of the succeeding crops.

The after-ripening process necessary before certain seeds will germinate is the result of inhibitors present in the seeds. This is another source of starting materials for a herbicide synthesis program.

While I realize that many of my suggestions are by no means new and novel, I do feel that we could exploit naturally occurring plant inhibitors more fully.

I think that the people whose job it is to direct herbicide synthesis and screening programs, have one of the most fascinating jobs I know of. There is such a broad field to cover, one can let his imagination run wild and he is sure to come up with something of value in short order. The relatively large number of new herbicides that have been developed in this country in the last few years attest to this fact. While I realize that management might frown on some of the "long hair" approaches that I have mentioned, I believe they will pay off in the end.

I was pleasantly surprised this summer while visiting abroad to learn of the large effort that Imperial Chemical Industries places in basic research. While such action might not yield immediate dividends it is certain to do so several years hence.

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THE DEVELOPMENTAL MORPHOLOGY OF WILD OATS (Abstract)

John G. Green and E. A. Helgeson [1]

Since a basic understanding of the growth habit of wild oats (*Avena fatua*) will aid in defining the problem and deriving a satisfactory method of control, a study of the developmental morphology and anatomy of the noxious weed was begun in 1957. A preliminary

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report of findings regarding morphology is reported in this paper.

Spring sown wild oats was sampled throughout the growing season at five day intervals. Pertinent measurements regarding the growth habit of the plant were taken at each sampling. In addition, material was placed in FAA for histological examination and in fifty percent ethanol for morphological studies.

Spring germination appeared to be dependent largely upon soil temperature and moisture. Imbibition of water by immersed seeds occurs rapidly during the first hour of immersion, but part of the rapidity of water uptake appears to be due to the rapid absorption of water by the hygroscopic hull, the lemma and palea, enclosing the seed. The moisture content of the seed reaches equilibrium at approximately forty percent moisture at forty hours of immersion and aeration.

In germination, the coleorhiza emerged followed shortly by emergence of the coleoptile in three to five days. Three seminal roots emerged and penetrated into the soil. Persistence of the seminal root system was variable. The first true leaf emerged through a pore near the apex of the coleoptile. The leaf appeared to be functional when it appeared.

Vegetative growth occurred slowly at first, the plant attaining a height of ten inches by the thirtieth day from planting. During this interval, all leaf initials were formed and differentiation of the panicle initials had begun. Growth accelerated, due to activity of the intercalary meristems at the base of each internode, although the earliest formed growth nodes elongated the smallest amount. Growth ceased rather abruptly at about the sixty-fifth day when the plant had attained an average height of fifty inches. Elongation occurred in only five or six of the twelve internodes of the plant, elongation per internode increasing acropetally.

The number of functional leaves underwent a rather definite cycle, the number increasing from one at five days to about six at forty-five days, then dropping to zero at about seventy-five days. The youngest leaf, the flagleaf, persisted the longest. Factors contributing to deterioration of the leaves were piercing by adventitious roots, pressure of developing tiller buds, shading, senescence, and disease.

The development of the adventitious root system from the intercalary meristems at the bases of six internodes closely paralleled the growth pattern. At the time of maximum development at about seventy-five days, the number of adventitious roots ranged from twenty to seventy.

The number of adventitious roots was related to the number of tillers produced, since the lower two internodes of each tiller produced whorls of roots from basal intercalary meristems. The first tiller emerged from the prophyllum at about the twentieth day, the number reaching an average high of seven by the fortieth day, though a great deal of variation occurred. Since the prophyllum and four internodes of each tiller as well as five internodes of the main culm produce tiller buds from intercalary meristems, vegetative reproduction appeared to be potentially vast. However, a maximum of only eight tillers reached maturity, the number ranging from one to eight per plant. Tiller number appeared to be responsive to competition and edaphic conditions.

Seed production was related to tiller production, some plants producing as many as five hundred seeds. Branches of the nodes of the panicle originated as initials from the apical meristem. In general the panicle matured basipetally, but each spikelet matured acropetally. Florets appeared to be self-pollinated about the fifty-fifth day. Since the tillers matured slightly faster than the main culm, all seeds matured at about the same time. The tertiary and secondary seeds began abscissing at about the seventieth day achieving about ninety-seven percent seed fall by the nintieth day. Primary seeds were more tenacious, beginning to fall at about the seventy-fifth day and reaching seventy-five percent fall by the nintieth day.

The seed which fall to the ground will remain dormant for a varying period of time—four months or more. In the spring surviving seed will germinate and the cycle of development will be repeated.

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THE HERBICIDAL ACTION OF IPC AND CDAA ON WILD OATS AND SEVERAL CROP PLANTS

D. T. Canvin and G. Friesen [1]

Relative toxicity on several plant species

The toxic effects of IPC and CDAA were determined on wild oats, Parkland barley, Chancellor peas and Raja flax. It has been observed from field tests that, at herbicidal rates, wild oats and barley are susceptible to both herbicides, flax is susceptible to IPC, and peas are considered resistant to both. Since both herbicides are considered effective only when in direct contact with germinating seeds or very young seedlings, phytotoxicity was determined on the germinating seeds and was measured by root and shoot growth inhibition. Seeds were placed in petri plates containing 5 ml of the herbicidal solution at the desired concentrations and allowed to germinate for 96 hours under room temperatures. "Control" petri plates contained 5 ml of distilled water. Root and shoot growth inhibition after 96 hours were used to measure the herbicides' phytotoxicity. Since root and shoot inhibition followed similar trends, only root growth data are presented here.

Table 1. The effect of CDAA on root growth of wild oats, barley, flax and peas

Concentration	Root growth after 96 hours Percent inhibition			
	Wild oats	Barley	Flax	Peas
Control	0	0	0	0
0.01 ppm	5	4	0	0
0.1 ppm	33	10	0	7
1.0 ppm	74	38	0	16
10.0 ppm	86	74	12	23
100.0 ppm	96	94	100	28
1000.0 ppm	100	100	100	100

The narrow differential in the amount of inhibition between barley and wild oats indicates that barley is slightly more resistant to CDAA treatment. However, the differential would not seem to be large enough to allow for wild oat control without considerable damage to the barley. Flax and peas appear highly resistant to CDAA at concentrations up to 10 ppm, with peas being somewhat more resistant than flax.

Table 2. The effect of IPC on root growth of wild oats, barley, flax and peas

Concentration	Root growth after 96 hours Percent inhibition			
	Wild oats	Barley	Flax	Peas
Control	0	0	0	0
0.01 ppm	0	0	0	0
0.1 ppm	49	0	0	34
1.0 ppm	93	76	0	34
10 ppm	94	74	58	44
100 ppm	97	85	74	58
1000 ppm	100	100	100	100

Although there is a slight difference in tolerance between barley and wild oats, it is evident that considerable damage to barley would result from IPC treatment to control wild oats. Of interest is the resistance

of flax to IPC at the 1 ppm concentration, and the relative intolerance of peas to even a 0.1 ppm solution. This, however, has not been demonstrated in field trials.

Cytological Effects

The cytological investigations were confined to barley and peas because of their low chromosome number. Root tips were collected for examination 96 hours after germination from plots treated with 0.1, 10 and 100 ppm solutions. They were fixed in Navashin fluid (1) for 3 hours. After a thorough washing they were dehydrated and embedded in paraffin using the alcohol-*n*-butyl alcohol schedule of Randolph (3). Sections were cut at a thickness of 12 microns using a rotary microtome. The paraffin was dissolved in xylol and the sections rehydrated using ethyl alcohol. The sections were stained using a modification of Johansen's quadruple stain (2).

The effect of CDAA on the number of dividing cells in longitudinal sections of barley roots is presented in the following table.

Table 3. Effect of CDAA on the number of dividing cells in longitudinal sections of barley root tips

Concentration	Number of dividing cells (average from 100 longitudinal sections)
Control	33.7
1 ppm	30.4
10 ppm	8.2
100 ppm	1.5

The barley roots grown in 1 ppm CDAA showed only a slight decrease in number of dividing cells, indicating a sub-lethal dosage. Those grown in 10 ppm CDAA had relatively few dividing cells and those treated with 100 ppm had practically none. A slight disarrangement of cells was observed following treatment at the highest concentration.

IPC at the lowest concentration studied, (1 ppm), inhibited cell division completely in barley roots. Root and cell structure appeared normal but no dividing cells could be seen. When higher concentrations of IPC were used (10 and 100 ppm) cell structure and root structure were disarranged. Cells in the constricted tips were elongated and narrow, while cells in the swollen region were large and vacuolate. The orderly arrangement of the cells into rows which was apparent in normal barley roots was not apparent. Endopolyploidy was common and many large cells completely filled with chromosomes were observed. These cells were highly polyploid and appeared to be in a state of prolonged pseudometaphase. In some of these polyploid cells clumping of the chromosomes could be observed with the clumps often being unequal in size or stuck together in long chains. This type of polyploidy could only result from repeated division of the chromosomes with no separation taking place. The presence of tripolar and polypolar anaphases gave further evidence to show that the spindle mechanism was affected. With the subsequent failure of the cell walls to form, these anaphases resulted in cells containing three or more restitution nuclei. These nuclei were often misshapen and unequal in size. Even when a bipolar anaphase separation occurred the cell wall often failed to form and a cell containing two nuclei resulted. Only in a very few cells did division appear normal.

CDAA appeared to have only a single cytological effect on barley growth. At all concentrations cell division was inhibited—the absolute extent of such being directly proportional to the concentration of CDAA. IPC would appear to affect the growth of barley roots in at least two ways. First, at the lower concentration, it hindered cell metabolism so that cell division ceased. Secondly, at higher concentrations it directly affected cell division so that division became abnormal.

The effect of CDAA and IPC on the number of dividing cells in longitudinal sections of pea root tips is presented in Table 4.

Table 4. Effect of CDAA and IPC on the number of dividing cells in longitudinal sections of pea root tips.

Concentration	Number of dividing cells (average from 100 longitudinal sections)
Control	76.3
CDAA 1 ppm	73.2
CDAA 10 ppm	68.7
CDAA 100 ppm	62.4
IPC 1 ppm	70.1
IPC 10 ppm	56.9
IPC 100 ppm	41.2

The pea roots which were treated with 1 (one) ppm CDAA or IPC did not markedly differ from normal roots. However, as the concentration of chemicals was increased there was a decrease in the number of dividing cells. In no case was cell division completely inhibited at 96 hours after treatment. Thus both chemicals appear to have only one effect on this resistant species, i. e. inhibition of cell division directly proportional to concentration.

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SOME FACTORS AFFECTING THE GERMINATION OF THREE SPECIES OF SMARTWEED[1] (Abstract)

D. E. Bayer and K. P. Buchholtz[2]

The seed dormancy of three species of smartweed, Pennsylvania smartweed (*Polygonum pensylvanicum*), ladysthumb (*Polygonum persicaria*), and pale smartweed (*Polygonum lapathifolium*) was investigated by studying pre-planting and germination treatments.

An aspirator was used to separate the seed for uniformity of size and weight. One-hundred seeds were placed in 25 x 200 mm test tubes and the pretreatment solutions were added. Special care was taken to submerge all seed immediately after addition of pretreatment solution. This was done to insure uniformity of treatment to all seeds. After subjecting the seeds to the various treatments they were placed on dampened filter paper in a petri dish and germinated. A seed was considered to be germinated when the root and hypocotyl attained a length of 0.5 to 1.0 cm or more.

Seeds submerged in water and held at 2°C from 4 to 6 weeks gave maximum germination. A 0.2 per cent potassium nitrate solution may be used instead of water in the above treatment with a slight increase in germination at shorter pretreatment intervals. Potassium nitrate was more effective for overcoming the dormancy of pale smartweed than Pennsylvania smartweed or ladysthumb. Contamination may have been an important factor when potassium nitrate was used.

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The effect of alternating temperature, 20-30°C, (20°C for 16 hours and 30°C for 8 hours) and light (8 hours light and 16 hours dark) on the germinating seed of Pennsylvania smartweed, ladysthumb, and pale smartweed was determined. The petri dishes for the dark treatment were wrapped in a double sheet of aluminum foil and placed in the germinator with the petri dishes containing the seeds to receive light.

Both Pennsylvania smartweed and ladysthumb showed no marked benefit in germination from either the alternating temperature or the light. However, pale smartweed showed a very marked increase from the presence of light and alternating temperature.

A secondary dormancy was introduced into the seeds of the 3 species of smartweed by subjecting the seed to 30°C and dry air for 24 hours after the primary dormancy was broken. This secondary dormancy was broken slowly when subjected to treatments similar to those used for breaking the primary dormancy. Seeds of ladysthumb overcame this induced dormancy more rapidly than Pennsylvania or pale smartweed. After 8 weeks of treatment the seeds of Pennsylvania and pale smartweed had recovered approximately 50 per cent of their original germination.

Primary dormancy may be overcome by soaking the seeds in water for a period of 4 to 6 weeks at 2°C. Germination may be improved by the presence of light when germinating pale smartweed. Drying of the seed at slightly elevated temperatures after breaking primary dormancy introduced a secondary dormancy in pale and Pennsylvania smartweed which is more difficult to overcome than the primary dormancy.

[1] Published with the approval of the Director of the Wis. Agri. Exp. Station. Supported in part by the Pittman-Robertson project 9R of the Wisconsin Conservation Department.

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FIELD AND LABORATORY GERMINATION OF THE SEEDS OF BINDWEEDS, VELVET LEAF, AND LADYSTHUMB

(Abstract)

G. P. Steinbauer and Buford Grigsby[1]

Hard-seededness in the bindweeds, *Convolvulus arvensis* and *Convolvulus sepium*, may persist for several years in dry storage. The most complete germination of seeds of *C. arvensis* was obtained in the laboratory by using Porter's method, consisting of treatment of the seeds with conc. sulfuric acid for 1 hour, followed by a one half hour rinse in running water and then placing the seeds on moist germination blotters in petri dishes at 20-30°C. Germination is complete in 5 days. For field or greenhouse plantings the seeds may be surface dried after the acid and rinse treatment to facilitate handling. The same methods were equally successful for germinating seeds of *Convolvulus sepium*.

Hard-seededness in velvet leaf, *Abutilon theophrasti*, was less persistent than in the bindweeds. Some lots of seed with a very high percentage of hard seeds at harvest became permeable within a year. Several methods were used to break the hard seed condition. Of these the most effective was to immerse the seeds in conc. sulfuric acid for 15 minutes, rinse them in running water for 1 hour after which they were surface dried for field or greenhouse planting or tested for germination in the laboratory as outlined above for bindweeds.

Seeds in ladysthumb, *Polygonum persicaria*, in common with those of other smartweeds, usually exhibit persistent dormancy in dry storage. The most successful method of inducing germination of the seeds in the laboratory and in the field consisted in immersing the seeds in conc. sulfuric acid for 15 min., rinsing in running water for an hour, and then prechilling the seeds at approximately 5°C. for 1 week, after which they may be tested for germination in the laboratory as for bindweeds, or surface dried and planted in field or greenhouse. Germination should be complete in about three weeks.

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SEED PRODUCTION IN CANADA THISTLE AND PERENNIAL SOWTHISTLE

R. E. Schultz, L. A. Derscheid & G. A. Wicks[1]

Two general factors were studied: (1) seed maturation and (2) mode of pollination.

Seed Maturation

Experiments were conducted to learn (1) the age of flowers when viable achenes were produced, (2) when to mow to prevent production of viable achenes and (3) when to spray to prevent production of viable achenes.

Age of Flowers. Four experiments were conducted—one on Canada thistle *(Cirsium arvense L.)* and one on perennial sowthistle *(Sonchus arvensis L.)* in each of two years, 1956 and 1957. In each case all flowers were removed from a patch of thistles in mid-July. The next day tags were placed on flowers that opened during the intervening twenty-four hours. From 50 to 75 heads were harvested daily in each experiment for a period of 10 days to two weeks. Twenty heads from each date in each experiment were threshed separately, the achenes counted and the achenes from each head were germinated separately.

Over 80% of the Canada thistle achenes were viable in heads harvested on the 11th day in 1956 and 9th day in 1957 after the heads opened. About 12% were viable on heads harvested 1 day earlier and less than 1% were viable on heads harvested 2 days earlier, each year. A high percentage of the achenes were viable on 9-day-old perennial sowthistle heads in 1956 and on 8-day-old heads in 1957. Achenes matured one or two days earlier for each species in 1957 than in 1956. However, the data indicate that achenes of these species become viable 7 to 10 days after the heads open.

Effect of Mowing on Seed Production. Four more experiments (two on each species each year, 1956 and 1957) were handled in exactly the same manner, except that entire plants were mowed at daily intervals after the heads opened and allowed to dry in the field for three days. Germinations were also conducted in the same manner.

When mowing of Canada thistle was delayed until the 11th day in 1956 and the 8th day in 1957, a high percentage of the achenes were viable. Likewise, perennial sowthistle heads, allowed to become 9 days old in 1956 and 8 days old in 1957 before being mowed, produced a high percentage of viable achenes. Less than 8% of the achenes were viable on plants harvested one day earlier in each experiment.

These data indicate that thistles must be mowed before the flowers are 8 to 11 days old in order to prevent

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viable seed production. They also indicate that the achenes do not develop on plants after they are mowed.

Effect of 2,4-D on Seed Production. Perennial sowthistle was sprayed with one-half pound acid equivalent of a 2,4-D ester per acre in 1956 and 1957 and Canada thistle was sprayed with an equal amount of a 2,4-D amine in 1957. Heads that opened 2 days and 7 days after spraying were harvested in 1956. Heads that opened 2 and 4 days before spraying, the day of spraying, and 2, 4, and 6 days after spraying were harvested from both species in 1957.

There were 3 or 4 times as many achenes per head on sprayed heads of sowthistle in 1956 and about twice as many in 1957 as there were in unsprayed heads. The number was increased slightly in Canada thistle as well. However, none of the 1956 sowthistle achenes were viable and from 0.1 to 9.7% of the 1957 Canada thistle achenes produced seedlings. The 1957 sowthistle achenes are now in the germinator. These data indicate that spraying as late as flowering time will prevent viable seed production.

Mode of Pollination

Two main factors were studied; (1) pollinating agents and (2) source of pollen.

Pollinating agents. During the winter of 1955-56, honey bees were put in the greenhouse with Canada thistle plants that were flowering. After the bees were removed, two 18-inch fans were used to force air over a second crop of flowers for 9 hours a day for two weeks. During the winter of 1956-57 both species of thistles were treated in a similar manner.

Canada thistle heads pollinated by bees produced an average of 43.5 mature achenes per head in the first experiment and 45.3 in the second. Heads pollinated by wind produced an average of 0.76 achenes per head in 1955-56 and 0.21 in 1956-57. Hand pollinated heads produced 68.5 achenes per head in 1955-56. Sowthistle produced an average of 57.7 mature achenes per head when pollinated by bees and 0.84 when pollinated with wind currents. These data indicate that insects, such as bees, may play an important part in pollinating thistles.

Source of Pollen. It has been known for some time that Canada thistle heads are functionally unisexual and therefore must be cross-pollinated, but sowthistle has complete flowers and it was not known whether it was self-pollinated or cross-pollinated.

In the greenhouse during the spring of 1957, one-hundred heads of sowthistle were self-pollinated by hand. Ninety-one heads failed to produce seed, and the other nine produced an average of 172 achenes per head, but only one achene was viable. Also 100 heads were cross-pollinated with pollen from flowers on the same plant. Ninety-five failed to produce seed and the other 5 produced an average of 127.5 achenes per head but none of them were viable. Ten heads were cross-pollinated with pollen from flowers of different plants and produced an average of 47.9 achenes per head, 80% of which were viable.

A similar experiment was conducted in the field during the summer of 1957. One-hundred heads were self-pollinated, 24 were cross-pollinated with flowers on the same plant and 100 were cross-pollinated with flowers on different plants. Of the self-pollinated heads, 91 failed to produce seed, 4 produced an average of 2 fruits and 5 produced an average of 127. Of the 24 that were crossed with heads on the same plant, 16 produced an average of 1.5 fruits and 8 produced an average of 110 achenes per head. Of the 100 that were crossed with heads on different plants, 14 failed to produce seed, 5 produced less than 5 fruits per head and 81 produced an average of 45.9 achenes per head. The achenes are in the germinator at this writing and appear to be following the same pattern as those grown in the greenhouse. These data indicate that even though perennial sowthistle flowers are bisexual, they are largely self-sterile. It is possible that the same type of self sterility that exists in sweetclover exists in perennial sowthistle.

[1] Graduate assistant (deceased), Associate Agronomist, and Graduate Assistant, South Dakota State College, respectively. Research done in collaboration with NC Regional Project 10, Subproject 3.

CHLOROSIS AND GROWTH EFFECTS AS INDUCED BY THE HERBICIDE 3-AMINO-1,2,4,-TRIAZOLE

(Abstract)

B. J. Rogers[1]

It has been found possible to study, independently, two effects of amino triazole (ATA). Chlorosis can be shown in young corn plants without any apparent effect on growth over a period of 10 days to two weeks. The corn leaves (at sublethal rates of ATA) only show chlorosis on those portions of leaf still hidden in the whorl at the time of herbicide application. The chlorosis could be due to either inhibition of chlorophyll synthesis or inhibition of plastid development. The two processes seem to be interdependent. There are some data which suggest that chlorophyll synthesis is not inhibited: (1) ATA at 10^{-3} M does not inhibit incorporation of glycine into porphyrin rings; and (2), ATA will not prevent the formation of chlorophyll from protochlorophyll in etiolated corn leaves. Other steps in the synthesis remain to be investigated.

The absence of grana and discs (and so presumably plastids) from electron microscope pictures of particulate fractions from ATA-chlorotic corn leaves indicates that plastids did not form. No evidence for intermediate steps in plastid development has been found as yet.

The growth effect of ATA was shown in a series of *in vitro* cultures of carrot tissue. At a concentration of approximately 10^{-4} M ATA, there was an increase in growth of some 40 percent over that of a control. At 10^{-3} M ATA, growth was only 35-40 percent that of the control. Hence, ATA both increases and decreases growth, depending on concentration.

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THE ABSORPTION AND TRANSLOCATION OF C^{14}-LABELED ATA AND 2,4-D IN CANADA THISTLE (Abstract)

D. D. Bondarenko[1]

The absorption and translocation of C^{14}-labeled ATA and 2,4-D in regrowth Canada thistle, after mowing, in the field and in the greenhouse in August, 1957 and the first two weeks in September was studied by autoradiography. The ATA had a specific activity of 0.94 mc per mM, the 2,4-D, 1.0 mc per mM. Two mg of ATA in 0.04 ml of water, or 4 mg 2,4-D in 0.08 ml of 50 per cent ethanol, were applied per plant unless otherwise stated. A small lanolin ring was prepared on the upper surface over the midrib of the broadest, longest, and darkest green leaf, which was usually situated about midway on the stem, to confine the labeled solutions.

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After predetermined periods of time, the treated plants were dug up and the soil was washed from the roots. Then all the leaves were removed, placed in a herbarium press to dry, and glued on sheets of paper in the same relative positions as they were on the plant. The stems and roots were dissected into longitudinal and cross sections, glued on thin cardboard sheets and then frozen on dry ice. Most of the frozen mounts were lyophilized; the others were wrapped in Saran wrap and kept frozen. Ansco non-screen X-ray film was exposed to the dry mounts at room temperature and to the frozen mounts in a deep freeze for 28 days and then developed, fixed, and dried.

Autograms were made of two treated plants in each phase of the experiment, and of two non-treated plants. Autograms produced by exposure to the non-dehydrated, frozen mounts were as satisfactory as those by exposure to the dry mounts. Autograms produced by these methods indicated that the non-treated plants contained no labeled material. Autograms of thistle plants treated with ATA and 2,4-D in the field and dissected 1 hr, 4 hr, 8 hr, 24 hr, and 1 wk later showed that the chemicals were absorbed and translocated at about the same rate, but that they did not concentrate in the same parts of the plants after the longer treatment periods. After 1 hr, both chemicals had moved from the receptor leaf into all the other leaves except a few dead ones at the base of the shoot and were concentrated mainly in the midrib almost to the tip of the leaves. Both chemicals were uniformly distributed in small quantities throughout the aerial and underground parts of the stem and in the roots to a depth of about 1 ft. 2,4-D was also detected in one live shoot and in a dead stem, both of which were attached to the same root runner as the receptor shoot. After 4 hr, ATA and 2,4-D were distributed in the shoots in essentially the same pattern and amounts as they were 1 hr after treatment. However, after 8 hr, 24 hr, and 1 wk, in the leaves, ATA tended to concentrate increasingly with time in the young leaves at the top of the stem, whereas 2,4-D concentrated mainly in the leaves below the receptor leaf with little or none in the young leaves at the top. Both chemicals had spread from the midrib over the entire leaf. At the same time, in the stems and roots, ATA concentrated in and near the stem tip, but considerable amounts of ATA also were present in the rest of the stem and in the roots. In comparison, little or no 2,4-D was present in the stem tip but considerable, rather uniformly distributed, amounts were present in the remainder of the stem and in the roots with slightly more in the aerial part of the stem than below ground or in the roots.

In the leaves of shoots that were subjected to darkness for 96 hr., treated with ATA in diffuse light, and then returned to darkness for an additional 96 hr, ATA concentrated in the receptor leaf with a secondary, but less pronounced, maximum in the younger leaves at the top of the shoot. The intermediate leaves and the leaves below the receptor leaf contained little ATA. Considerable ATA was detected in the stem between the terminal apex and the soil surface level. Only sufficient ATA to produce a faint image in the autogram was present in the underground portion of the stem. Under the same treatment conditions, 2,4-D at 2 mg concentrated in the tip of the receptor leaf, along the midrib down to the stem, and in lesser amounts in the stem for a distance of 2 in above and 3 in below the receptor leaf and in the midrib of 4 leaves above the receptor leaf. No 2,4-D was detected in any of the other parts of the shoots.

Live aphids were collected from thistle plants treated with labeled ATA and 2,4-D, pressed and dried between two cardboard sheets and exposed to X-ray film for 60 days. Dark images of the aphids occurred in the autograms, which indicated that the aphids undoubtedly extracted the labeled chemicals from the treated plants.

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EFFECTS OF QUACKGRASS RHIZOMES ON GERMINATION AND GROWTH OF CROP SEEDLINGS (Abstract)[1]

Thor Kommedahl, J. B. Kotheimer, and J. V. Bernardini[2]

Many farmers have found it difficult to establish alfalfa on newly-plowed sod of quackgrass (*Agropyron repens* (L.) Beauv.). In field tests with two varieties of alfalfa (Ranger and Narragansett), it was found that the stands on non-infested land were double and the dry matter per plant was 2.5 times that on previously infested land. Alfalfa seedlings grown in pots containing ground rhizomes were stunted and often chlorotic. After one month, the alfalfa tops were cut, dried, and weighed and the top growth was 65% less than controls.

Because adding rhizomes increases the organic matter in soil, water extracts from rhizomes were tested by daily watering of alfalfa plants growing in the greenhouse. This resulted in 60% less top growth (dry weight) than the control (watered daily with tap water). The ground rhizomes that were steeped in water were redried and mixed with soil that was seeded to alfalfa. This resulted in 80% less top growth (dry weight) of 6-week-old plants, than the controls.

The stand in previously infested field plots of 3 varieties of wheat (Lee, Mida, and Selkirk) averaged one-third and the dry weights per plant one-half that on non-infested plots. In the greenhouse, 3-week-old wheat seedlings averaged nearly 5 cm taller on non-infested soil than on previously infested soil (rhizomes removed). Moreover, the dry weight per seedling was twice as great on non-infested soil. Autoclaving soil did not change results.

When 20 gm of ground rhizomes were added per pot of non-sterile soil, germination of Selkirk wheat after 7 days was 4%, compared to 71% for controls. In another test using 5, 10 and 15 gm of sterile ground rhizomes per pot of autoclaved soil, germination after 7 days was 71%, 65%, and 35%, respectively, compared to 86% for the controls. A third test at 10 and 20 gm per pot gave 73%, for the 10 gm and 42% for the 20 gm amounts, compared to 72% for the controls. In all tests, differences were apparent after a week or so; after several weeks, stands in all pots were virtually the same except in pots of non-sterile soil. Thus the effect was only to delay germination, at least where sterile soil was used. In non-sterile soil, grains of wheat often decayed in soil containing rhizomes, perhaps predisposed by toxic substances in quackgrass to rot by pathogens in soil. Even though stands were the same the plants were severely stunted.

In field tests, three varieties of oats (Ajax, Bonda, and Rodney) averaged one-fourth less stand and one-half the dry weight at heading time, in comparisons of plants grown in previously infested and non-infested land, respectively. Oats grown in soil contained in flats previously occupied by quackgrass in the greenhouse produced seedlings that were 2.5 cm shorter after three weeks than those in controls. Moreover dry weights of seedlings in infested soil were two-thirds that of controls —not as great a difference as for wheat.

Barley was affected in field tests more than were wheat and oats, for the stand of the varieties Kindred, Montcalm and Peatland in infested plots was about half and the dry weights about one-fourth that of non-infested plots. However, fungi isolated from rhizomes of quackgrass were pathogenic to barley and seedling blight of barley was more severe when a root-rotting pathogen was combined with ground rhizomes.

No differences were found in stands of flax in the field or greenhouses; however, there was a tenfold increase in dry weight per plant on non-infested field plots, compared with previously infested ones. The flax varieties were B5128, Marine and Redwood.

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AN ENZYMATIC STUDY OF THE DORMANCY OF QUACKGRASS RHIZOMES[1] (Abstract)

B. G. Johnson and K. P. Buchholtz[2]

From a two-year study of the dormancy of buds on rhizomes of quackgrass, it was observed that during June and early July the ability of these buds to grow was greatly reduced. The present study was begun in an attempt to determine the causal factors of this bud dormancy.

The enzyme system chosen for this study was indoleacetic acid oxidase. It is of widespread occurrence in plants and oxidatively converts the plant growth hormone indoleacetic acid (IAA) to a physiologically inactive, yet unknown, degradation product. It is known that the amount of cell growth is quantitatively dependent on IAA concentration. Also the adaptive formation of this enzyme in response to concentrations of IAA has been observed. Therefore, it was believed that a measure of IAA oxidase activity may conceivably give some indication of the IAA concentration in dormant and nondormant rhizome tissue. This concentration could then be compared to the bud activity of dormant and nondormant rhizomes. A measure of naturally occurring inhibitory substances of the IAA oxidase system was also considered, since the concentration of these inhibitors could influence the activity of the enzyme.

At weekly intervals during the growing season, beginning in late March, samples of rhizome material were collected from a heavily infested quackgrass sod. In order to make samples comparable, two centimeter sections, each containing a single bud, were cut from healthy rhizomes. These samples were then quick frozen in liquid air and dried by lyophilization.

An exhaustive, cold water extraction, was used to extract the IAA oxidase and inhibitory substances since both are water soluble. A two gram sample of ground rhizome material was extracted and centrifuged, and the supernatent decanted. The total extract was split into two fractions. The fraction to be used to determine IAA oxidase activity was dialyzed to remove the inhibitory substances. The fraction to be used to determine the concentration of inhibitory substances was boiled to inactivate the enzymes present. A manometric method was used to determine enzyme activity, and oxygen uptake in microliters of O_2 was measured. A purified commercial preparation of horse radish peroxidase (HRP) was used as the standard against method.

In order to compare samples, uptake rates were plotted against time. For each sample the measure of enzyme activity was taken as the maximum rate of oxygen uptake over a ten minute period. These maximum uptake rates were compared with the bud activity curves for the growing season. There was very good agreement between IAA oxidase activity and bud dormancy. When the bud activity was high, IAA oxidase activity was high and when the buds were dormant, IAA oxidase activity was low. When the buds recovered from dormancy during July and August, enzyme activity again increased. When nitrogen fertilizer was applied to an area of quackgrass sod in the spring it caused a subsequent delay in bud dormancy and reduced the degree of dormancy. The same trend was also apparent in IAA oxidase activity of samples taken from this area.

A similar manometric method was used in the inhibitor study. The concentration of inhibitory substances present in the samples was determined by the length of the lag period prior to oxygen uptake. When the lag periods for all samples tested were compared, the concentrations of inhibitory substances were not conclusive in following any set pattern when compared to bud activity curves for the growing season. Lag periods ranged from one hour to as high as three hours for all samples tested. Since the concentration necessary for inhibition of IAA oxidase is extremely low, the inhibitory substances were present in concentrations capable of preventing enzyme activity, if at the site of activity of the enzyme in the plant cell, at all times during the year. It is conceivable, therefore, that concentrations of inhibitory substances are localized in the plant cell if the IAA oxidase enzyme system is to be considered physiologically significant.

If IAA oxidase is adaptive to concentrations of IAA and thus reflects the IAA concentration, the present study indicates that a sub-optimum concentration of IAA is present during dormancy. Further study of the various phases of quackgrass bud dormancy is necessary before one might say whether or not this IAA level is, in itself, the causal factor of dormancy or merely a contributing factor to dormancy.

[1] Published with the approval of the Director of the Wis. Agr. Exp. Sta. as a collaborator under North Central Regional Coop. Res. Project No. 10. The author wishes to express his appreciation to J. B. Mudd, Dept. of Biochemistry, for his assistance and advice in this study.

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PHENOLOGICAL AND BIOCHEMICAL STUDIES OF BUD DORMANCY IN TWO DEEP ROOTED PERENNIAL WEEDS. (Abstract)

Warren G. Monson and Neal E. Shafer[1]

Phenological studies on two species of deep rooted perennial weeds, leafy spurge (*Euphorbia esula* L.) and ironweed (*Vernonia Baldwini* Torr.), over a two year period have shown buds to be present in these species throughout the year. New buds are initiated following the development of new growth in the spring. Evidence was obtained indicating that bud dormancy occurs in these species during the late summer and early fall months and that it is broken naturally by low temperatures during early winter.

Peroxidase and polyphenolase activity of leafy spurge and ironweed bud extracts were measured at weekly intervals during the growing season and into the winter. These enzymes are reported on the basis of activity per unit of protein nitrogen.

Peroxidase activity of the leafy spurge bud extracts showed an extreme peak in activity about August first, thereafter it declined rapidly, showing the lowest activity during the months of September and October. Peroxidase activity of the ironweed extracts showed the highest activity during the early part of the summer, thereafter it declined rather steadily yielding the lowest activity during September and October. Thus in both of these species low peroxidase activity appears to coincide with the period of normal bud dormancy.

Polyphenolase activity of the leafy spurge bud extracts was very low throughout the season, being undetected at many sampling dates. By contrast, ironweed bud extracts exhibited rather high polyphenolase activity at all sampling dates. There was considerable variation in polyphenolase activity of ironweed extracts at some dates, but there was no consistent pattern which could be associated with dormancy.

[1] University of Nebraska, Department of Agronomy. Supported in part by funds from NC-10 Regional Technical Committee project on bud dormancy.

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THE ROLE OF GIBBERELLIC ACID IN OVERCOMING BUD DORMANCY IN CERTAIN PERENNIAL WEEDS I. LEAFY SPURGE AND IRONWEED

(Abstract)

Neal E. Shafer and Warren G. Monson[1]

Gibberellic acid was used both as a foliage spray and in lanolin paste on leafy spurge and ironweed in an attempt to activate dormant buds. Ironweed did not respond to either method of treatment nor did it respond to soil applications. Where applications were made directly on dormant crown buds of leafy spurge, treatment with lanolin paste was superior to a water spray. When topgrowth was removed prior to treating the exposed dormant buds, the spray treatment was as effective as the treatment with lanolin paste. Spraying the intact foliage of leafy spurge with gibberellic acid resulted in the most new shoot growth when compared to the other methods of treatment tested.

With leafy spurge, gibberellic acid stimulated growth of dormant crown buds, caused branching and new shoot development on old shoots, and stimulated the emergence of new buds. The effects of the gibberellic acid stimulant were similar to those associated with the removal of apical dominance, but the growth rate was several times that obtained when topgrowth was removed. Increasing the concentration of gibberellic acid from 25 ppm to 500 ppm resulted in increased plant response. New growth produced following treatment was lighter green in color with more attenuate stems. No consistent effects were noted on flowering but those flowers that did develop were distinctly more ramose.

[1] Agronomy Department, University of Nebraska, Lincoln, Nebraska. This work has been supported by funds made available through an NC-10 Regional Technical Committee project on bud dormancy in perennial weeds.

HISTORY AND DEVELOPMENT OF GRANULAR HERBICIDES

D. W. Rake[1]

The first extensive use of granular herbicides is slightly more than two decades old. Raynor (1), reporting on the control of St. Johnswort or Klamath weed *(Hypericum perforatum)* with chemicals, describes the results obtained with applications of dry borax. Plots established in 1934 and 1935 showed that efficient control of this range pest was obtained with borates and combinations of borates and chlorates. Following these field trials on this weed, granular agricultural mesh borax was first marketed as a means of chemical weed control. (The granule size of this material was 99% larger than 45 mesh, or slightly more than 350 microns, in diameter.) This market was soon expanded to the bindweed infested areas of the Midwest where sodium chlorate and salt were already being employed. Agricultural mesh borax was later replaced by another granular sodium borate marketed commercially as BORASCU. In 1948, a highly concentrated, granular, sodium borate was offered for sale under the trade name of Concentrated BORASCU. Both of these materials provided greater economy than the refined borax, but no change in their method of application.

Less than five years ago chlorates and borates dominated the granular herbicide market. The initial use of these materials along with common salt was approximately 25 years ago. The use of salt has been progressively declining during the last 10 to 12 years due to the bulk and the corrosive nature of the material. On the other hand, sodium chlorate and sodium borates have been progressivly increasing in spite of the new organic compounds and the new mixtures.

Although the Australian beetles finally replaced the use of borates for control of St. Johnswort, considerable quantities of granular sodium borate herbicides are currently used for weed control throughout the North Central States.

During the last few years, formulations such as the borate/substituted urea combinations, borate/chlorate, and borate/2,4-D, etc., have been commercially available. This increased demand for granular herbicides is attributed to the general increased interest in weed control plus the increase in weed control research and education. Two of these materials marketed as UREABOR and DB Granular are approximately equal in their granular characteristics. Both are formulated by combining two proven herbicides into a single herbicidal complex. Such compositions are also resistant to attack and decomposition by soil organisms. They possess a particle size of which the bulk of such particles consist of granules 200 to 700 microns in diameter (through 20, retained on 70 mesh, U. S. Standard Sieve). Applications of 1 pound/100 square feet provide approximately 400 granules/square inch of surface area. Laboratory and field tests indicate this will provide optimum particle distribution for maximum herbicidal efficiency. This granular particle size also parallels the work by Fisher *et al.* (2) on size of spray droplets. Results of their tests indicated coarse droplets, 400-500 microns, were equally or slightly more effective than fine droplets, 100 microns, for control of mesquite and range weeds. Several other granular herbicide formulations now available have a wide range in particle size and consist of an active material on an inactive carrier such as clay, sand, vermiculite, etc.

All of you are familiar with the identity of various compounds known as herbicides, insecticides, or fertilizers. However, oftentimes, we mistake the form in which these materials are sold. Just what is meant by the terms "granular," "powdered," or "pellet"? Webster defines granular as, "consisting of or appearing to consist of grains or granules." Many agricultural fertilizers or pesticides are often referred to as being granular—which in the broad sense of the word is true, but probably a more descriptive and accurate terminology would be "powdered" which means "the fine particles to which any dry substance is reduced by pounding, grinding, etc." or maybe the opposite, a "pellet," which means "a little ball."

Any attempt to differentiate between a granule or a fine particle is irrelevant. Perhaps the most practical approach would be to consider a material granular when free of fine particles, dust, or amorphous material which is easily suspended and/or transported from one place to another by normal air currents of low velocity.

Some 13 herbicides were listed in the first edition of the popular textbook, "Weed Control," by Robbins, Crafts & Raynor (3). Of these 13, three materials could actually be employed in their granulated form. These include borax, sodium chlorate and salt. The Weed Society of America (4) currently lists some 57 herbicides and the acceptable designations for publications. None of these materials as such are in granular form. If there are no advantages in granular formulations, then why are a number of these herbicides now being formulated as granular materials for field testing? Actually, a few of these formulations are already commercially available.

Let us consider for a moment some of the advantages inherent in granular herbicides responsible for this revolutionary trend!

1. The physical characteristics of granular herbicides offer economic benefits in material handling. A suggested rate of 1 to 2 lb/100 sq ft of a granular herbicide frequently receives a negative response

because of the apparent bulk. On the other hand, if we employ a water spray formulation at a suggested rate of 2 to 40 lb/A, this sounds more reasonable. However, the amount of water necessary for possible distribution increases this bulk in the range of 832 to 1,700 lb/A as compared to the low of 435 lb/A for the granular material.

2. Low cost application equipment can be employed. This equipment may range from a simple hand-operated mechanical spreader to conventional power spreaders or regular fertilizer spreaders. The inherent ease of application of granular herbicides eliminates the need for costly spray equipment or skilled operators to operate such application equipment.
3. Field testing indicates increased selectivity can be obtained with granular materials as compared to the same materials in spray forms. The phytotoxicity of some herbicides has limited them to pre-emergence treatments; a granular form may enable postemergence treatments.
4. Granular herbicides may enable herbicide application and planting to be made in one operation in the case of pre-emergence treatments on direct-seeded crops.
5. Granular herbicides reduce the danger of drift, often encountered with dusts and sprays.
6. Granular herbicides of uniform particle size will often improve distribution of the material on the ground.
7. Granular herbicides often reduce the volatility of some volatile compounds.
8. Some granular herbicide formulations greatly reduce the microbial decomposition of the active ingredients.

The advances and development in the agricultural engineering field have paralleled the growth and development of the agricultural pesticide market in general. New engineering developments have been essential for the proper use and application of these pesticides. Today, for example, the airplane might be considered as an essential farm tool, whereas several years ago it was strictly luxury transportation.

In view of the aforementioned advantages of granular herbicides and the consumer interest in such materials, along with the advances in engineering, continued expansion of such herbicides is indicated.

Granular insecticides (5) were first field tested around 1952 and, since that time, have continued to gain favor. Early in 1956, an article appearing in one of the technical agricultural journals (6) indicated that considerable progress had been made in recent years in the development of granular insecticides. This same article further stated that granular herbicides, although trailing somewhat in development and field testing, have demonstrated certain advantages over dusts or sprayed herbicides and appear to be well on their way toward commercialization.

Perhaps the extensive testing of many new granular herbicide formulations has been slow and the wide variety of granular herbicide formulations is just now approaching commercialization. However, granular herbicides have been offered for sale for close to a quarter century. Actually, it is our belief that granular materials, and particularly granular herbicides are really not a new or recent innovation, and their wide use and acceptance confirms this belief.

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SUBSTITUTED UREA HERBICIDES: A NEW TOOL FOR HIGHWAY MAINTENANCE

Arden M. Aanestad[1]

The use of the substituted urea herbicides as soil sterilants is becoming increasingly important in highway maintenance.

Improvement in visibility to make highways safer is the main reason for controlling vegetation along roadsides. Uncontrolled vegetation can create safety hazards by obscuring warning signs and signals, cutting off the view at crossroads, curves and driveways, especially in rural areas; and hiding parked work trucks, disabled vehicles, and pedestrians' paths. Highway efficiency and safety are impaired when vegetation damages pavement and shoulders by breaking up the top coating and thus causing dangerous rough breaks and loose aggregate. This damage also increases the expense of maintenance. Vegetation interferes with proper drainage, so that standing water may cause slippery spots or patches of ice in winter.

Dry grass and weeds along roadsides may become a serious fire hazard, through which roadside fires may spread through forests and across prairies.

In agricultural areas, roadside weeds may spread to crop land.

Weed control chemicals must meet a number of requirements. Usually the first requirement is economic. The chemist must do a better job at a practical cost.

The second requirement is safety; for working crews, to adjacent cropland and landscaping, and safety to people and animals passing through the treated area.

The substituted urea herbicides fit into the highway program where it is desirable to keep the ground free of vegetation for an extended period of time. Quite often they can be used in conjunction with mechanical mowing to eliminate vegetation entirely where the mechanical mowers can't reach it. Such areas include guard rails, culverts, bridge abutments and signs.

DuPont offers "Telvar" W Monuron Weed Killer and "Telvar" DW Diuron Weed Killer. These are both wettable powders for use in sprays. Monuron is included with other herbicidal materials in "Ureabor", Chlorea, H-174, and "Urox", which are generally recommended for dry application, although "Chlorea", particularly, may also be applied in sprays.

The "Telvar" weed killers are generally used at 40 pounds per acre, and one application provides at least one season control. They are non-volatile, non-corrosive, non-flammable, and low in toxic hazard to people and animals. The use rates of the monuron combination products start at 1 pound per 100 square feet.

The "Telvar" weed killers and combinations containing them are economical to use. Highway departments are using them around sign posts, under guard rails and along the "toe" of the road with excellent results.

Prevention of the weed problem is the feasible approach to good maintenance in preference to control after the problem is established.

As with all potent plant killers, maintenance personnel must use caution in handling "Telvar" weed killers. Care should be taken that no chemicals reach

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the root zone of valuable trees and other plants. Common everyday caution, full familiarity and knowledge of the product can forestall many minor problems.

In summary, "Telvar" W and DW weed killers and mixtures containing them are becoming increasingly important in highway maintenance. They can meet the rigid requirements of safety, ease of use, thorough control and especially resulting economy required by the state highway departments. They are available for both large and small scale use as spray or dry applications.

[1] Development and Service Representative, E. I. DuPont de Nemours and Company, (Inc.).

LOWERING ROADSIDE MAINTENANCE COSTS WITH A COMBINATION SPRAYING-MOWING PROGRAM

James R. Riddle[1]

The design sections of the state highway departments all across the nation are tremendously busy at this time planning the super highways to be built under the new federal interstate system. The effect of this, the largest public works program in the history of mankind, will be far reaching in all phases of transportation in this country. In general, the public is not yet aware of the change about to take place and the idea of driving great distances without so much as a traffic light or crossroad, seems but a dream.

Ohio has $100,000,000 of this new system already under construction with the schedule for completion of major portions to begin within a few months. Many more millions of dollars of contracts will follow at an accelerated pace in the next several years until Ohio's 1,360 miles of the interstate system are completed.

Already, those charged with the maintenance of the highways are planning their program. It is interesting to note that the billions of federal funds which are publicized as allocated to the new system, are for construction—nothing for maintenance. After the routes are constructed, it becomes a state problem to maintain these super installations at state expense. This means dual highways (in some areas dual-dual lanes) with many large structures (bridges, cloverleaves, etc.) on rights of way averaging 300 feet in width with about 27 acres per mile in vegetative cover. Needless to say, the maintenance of this new mileage, with all its facilities, will be very expensive as compared to the average highway of the present type. This cost added to a maintenance budget already under the stress of annually mounting labor and material costs will necessitate the adpotion of a streamlined, highly mechanized maintenance program not only on the interstate system but on all the highways if we are to work within our present sources of revenue.

In 1951, the Ohio Department of Highways had the first demonstration of the effectiveness of the use of weed spray on highway rights of way in reducing the overall mowing and weed control costs. That year the rights of way of all rural mileage within a single county were sprayed three times within the season with mixtures of 2,4-D and 2,4,5-T. The roadsides were mowed only as often as needed. Accurate costs of the spraying and mowing were kept. At the end of the season, the sum of the costs was compared to the mowing costs of previous seasons. In general the spraying-mowing cost was found to be about one-fourth less than the previous method of mowing only.

This difference in costs has continued through the years in approximately the same ratio. For example, during 1957 we sprayed the rights of way on 11,731 miles of rural highway at a cost of $220,692. The average cost for spraying and mowing this mileage for 1957 was $80.04 per mile. On approximately 4,000 miles of right of way not sprayed, the average cost of mowing for the year was $111.26 per mile, a cost of $31.22 per mile less for the spraying-mowing treatment than the mowing only program.

These figures represent the direct saving as a result of spraying. We feel, in Ohio, there are many other advantages or savings as well.

1. At least one less machine mowing of the right of way per season, and most all hand mowing can be eliminated by spraying. This frees the labor for use in patching and other roadway maintenance work performed during the summer months.

2. Winter brush cutting programs in the hilly parts of the state have all but been eliminated, freeing the labor force for other maintenance work.

3. Reduction in cost of equipment maintenance. One of the 12 divisions of the State estimates that their mowing equipment repair costs have been reduced by $2,000 per season.

4. Elimination of roadside weeds is resulting in a much heavier sod cover, therefore, better erosion protection.

5. As miles of weed spraying have increased in Ohio, lost man hours due to ivy poisoning among highway personnel have decreased. Surely there must be an equal benefit to the traveling public.

6. A weed-free roadside must be of some real benefit to the neighboring farmer especially if he is producing a seed crop.

7. The unmeasurable pleasure to the public of driving on a neat, clean, well cared for roadway, we feel, is of value too.

With all the advantages listed in behalf of a roadside chemical weed control program, it is not a simple or easy thing to establish. First, it requires the whole hearted support of the top administrators within the department, for there are many "conservation" and "nature lover" groups who will oppose it. Also there will be outlandish damage claims arise from time to time. These conditions do not allow for "faint hearts".

Second, outside technical advice and support on a state level is extremely necessary. We are very fortunate in Ohio to have Drs. C. J. Willard and E. K. Alban. Both have given many hours of their time testifying before legislative committees, explaining our program to agricultural groups, answering letters of complaints, and field investigations of damage claims, as well as advising us on specifications and various phases of the work. We are also fortunate to have the services of the Ohio State Department of Agriculture, Division of Animal Industry. Dr. Harry E. Goldstein, Chief of the Diagnostic Laboratory and Dr. J. F. Long, Toxicologist, performed many investigations for us. In spite of the large amount of data available from various sources, we found it to be more authoritative to have the research conducted locally by a laboratory in close association with the state Veterinary Association. Drs. Goldstein and Long performed many laboratory examinations and examinations in the field of animals allegedly poisoned by 2,4-D and 2,4,5-T, in cooperation with the local veterinarian, or independently where the owner refused to have a local veterinarian but made the claim of an animal's illness or death due to highway weed spray. Incidently, no case has been found where the injury was attributable to our 2,4-D or 2,4,5-T weed spray program.

Third, the advice and assistance from the manufacturers of the various weed spray chemicals and the weed spray contractors has been of great value to those of us in direct charge of the program. They have assisted us greatly in keeping it an economical operation.

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RIGHT OF WAY BRUSH CONTROL OF ELECTRIC UTILITY LINES

A. F. Bolgrien[1]

Our company (The Wisconsin Power and Light Company) serves an area of 15,000 square miles from the Illinois state line to the Northern part of Wisconsin, having a total of 15,000 miles of line, of which 11,000 miles are rural line serving 39,000 rural customers. We serve in 33 of the 71 counties, which include a large scenic resort area. You will note from the map this includes the Wisconsin Dells and Lake Geneva territory, which are summer resorts, and we serve in pheasant and deer hunting country as well as in the heart of Wisconsin dairyland.

We have been spraying brush on transmission lines for the past 7 years. Started with foliage application, and are now into a program of cut, trim and spray, and are now going over to a basal spraying application.

Four years ago we went into the stump spraying program where we spray the stumps of the trees and brush we cut. At this same time we went into a selective spraying program on our rural lines—some foliage and some basal applications. To date we have covered approximately 5,000 miles of our rural and distribution lines and 1,500 miles of transmission lines, which is a little over ⅓ of our total lines.

We are very pleased with the results. We have had representatives of the chemical companies from whom we purchase our chemicals check our methods and the results, and they give us a good report. Each of our local 13 districts sets up their spraying program in line with the manpower available and the brush problem within that district. We have encouraged a conservative program, feeling our way making sure all concerned understand and profit by each others experience, both good and bad. 50% of our districts are all the way into the program, 40% are well into it, and the other 10% have completed their sampling program.

All our crews are equipped with a 3 gallon hand sprayer or a 5 gallon knapsack sprayer. Ten of the 14 crews have portable power sprayers. They mix the chemical (2,4,5-T) and oil in 50 gallon drums and mount them on our regular line clearing trucks. Several of our districts have mounted the portable sprayer and drums on two-wheel trailers, and several of our districts have had the help of a contractor with a larger power sprayer mounted on a truck.

Our company is spending $600,000.00 a year to keep our lines clear of trees and brush. We are out looking for any ideas where we can do a better job for less money, and the spraying program is one method. This program of spraying must be sold to everyone concerned—the State, County and Township Highway people, the Conservation people, Rod and Gun Clubs, the Weed Commission, the farmers and property owners, and the highway patrolmen who maintain the roads.

Here is a report of one district who started the job of basal spraying on September 25, 1955 and continued through the winter. They covered 1,182 miles of lines and there were 2,180 spans (pole to pole) of brush sprayed. The manhours worked were 2,105. They used 500 gallons of chemical, 5,633 gallons of oil. The total cost was $10,227.00. The average cost per span of brush was $4.68, the average cost per mile of line covered was $8.65, and we can report that we have been checking this job since the date of completion and we got an 80% kill.

Our program is a selection program, selecting the location to spray and spraying only those species that will grow tall enough to grow into the lines. If it is over 6 feet high, we suggest cut it and spray the stump.

We have made extensive use of a film that is available which tells the story of chemical brush control, and we make it available to any group in our area interested.

In the past four years we have had eight claims for property damages; apple trees, rose bush, several rows of peas, some pickles; some small trees just planted by a garden club on roadside. Total cost to settle all claims was $300.00.

We hold meetings with our employees to explain the use of chemical in detail before starting out on our spraying program, and we have invited in representatives of the chemical companies who are always glad to cooperate to explain to our people what chemical will do. I would like to show you some slides of equipment we use and point out some mistakes **we** and some of our good neighbors, the rural cooperatives, telephone companies, and some townships have made in the spraying program, with the thought in mind that you may profit by our experience.

[1] Line Clearance Supervisor, Wisconsin Power and Light Co., Madison, Wisconsin.

RESULTS OF CURRENT RAILROAD WEED CONTROL RESEARCH AT IOWA STATE COLLEGE

W. M. Struve and W. E. Loomis[1]

This was the seventh year during which railroad weed control research has been conducted at Iowa State College under a cooperative agreement with the Engineering Division of the Association of American Railroads.

In the following summary of the results of this year's work, chemical effectiveness is indicated as percentage control, with 80 percent control or better being considered as satisfactory. Heavy rainfall in the test areas undoubtedly affected the performance of many of the chemicals used.

Combinations of dalapon, CMU (monuron; now sold as "Telvar W") and Brushmix (2,4-D 50% and 2,4,5-T 50%) at rates up to 30, 10, and 8 lb/A, respectively, were generally unsatisfactory, with control ranging from 50 to 80 percent.

CMU at 10 lb/A with 10 lb of ATA and/or 5 lb of Methoxone (MCPA) gave satisfactory control but were not significantly better than 10 lb of CMU alone. 10 lb of CMU with 120 lb of chlorate was slightly better than the CMU alone. The effect of the chlorate was undoubtedly reduced by heavy rainfall just after application. On the basis of many tests we consider a mixture of CMU and chlorate the most effective herbicide for roadbed applications in our area. CMU-chlorate combinations sprayed in solution were considerably more effective than equivalent rates applied in the dry pellet form.

Simazin at 5 and 10 lb/A was applied alone and with chlorate and Methoxone. Although inconclusive, the results suggest that Simazin will be worthy of more extensive trial if it proves to be cost competitive with CMU.

The oils used in this year's tests fall into two performance groups. Conoco weed oil, Standard L-8764, and Cox 6 gave 70-75 percent control with a single July application, while Cox 60, Cox 77, Agronol R, and Lion HO-6 gave controls ranging down from 65 to 45 percent. These oil tests substantiate to a certain extent the hypothesis that the effective phytotoxicity of an oil is determined largely by the amount of polycyclic compounds which it contains.

A group of experiments involving continued appli-

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cation of several chemicals according to various spray programs was started in 1953 and continued through 1957. The data for 1957 are included in Table 1, and some three-year average figures in Table 2. We feel that these tables contain the most useful information on roadbed vegetation control for Midwest conditions that we have obtained to date. They indicate that the spray system may be more important than the chemical, and that reduced costs and improved control of vegetation may result through the use of a properly planned program.

The results in a wet season also indicate the importance of all-season control, either by the use of persistent chemicals or of repeated treatments as needed. Failure to maintain continuous control permits annual weed seeds to build up on the track until the removal of perennial species may result in more rather than fewer weeds, with most or all of their undesirable effects.

These spray plans have proved effective under conditions of only moderately long summers with poor to good summer growing conditions. They would need modification in the Southeast, probably by the addition of a second oil or similar light spray, and a single treatment might be adequate in regions of very dry summers. They emphasize that satisfactory vegetation control on poorly ballasted roadbeds requires the prevention of seed production by annual plants as well as the elimination of perennials.

We suggest that those in charge of the vegetation control program for a railroad system plan to do four things:

1. Spray the tracks most heavily infested with resistant perennials with a "heavy" spray. This may be expensive but will need be given only occasionally.

2. Follow up, in the first year if necessary, and in subsequent years, with a light spray treatment repeated often enough to hold remaining perennials in check and to prevent seed production by annuals.

3. Treat small areas of particularly persistent perennials heavily with soil sterilant chemicals. These occasional weed patches can probably be most economically handled by local section crews.

4. Remember that vegetation control is a continuous problem, and have equipment, either owned or contracted, to do the job when needed.

Table 1. Results of Continued Treatments and Spray Plans Test.

Treatment[1]	Alt. yrs. '53-'55-'57	Each yr. '53-'57	Each yr. plus oil[2]
TCA-40	13	11	91
TCA-40; Chlorate-80	30	35	97
Same plus 2,4-D-2	13	12	96
Chlorate-160	27	56	97
Oil (L-8764)-100 gal.	32	35	89
CMU-10	87	87	95
CMU-20	94	97	99
CMU-10; Chlorate-80	90	92	98

[1] Applied in early May. Rates indicated are pounds per acre of active ingredient.

[2] Oil applied in early July.

Table 2. Average of Spray Plans—All Treatments.

Year	Alt. yrs.	Each yr.	Each yr. plus oil
1955	68	84	89
1956	46[1]	73	95
1957	48[2]	53[2]	95
Average—3 years	54	70	93

[1] Not sprayed in 1956.

[2] Reduced late season control in a wet year.

[1] Iowa Agricultural Experiment Station, Ames, Iowa

EFFECTIVE CHEMICALS—GOOD APPLICATION: THE KEYS TO BRUSH CONTROL

Henry F. Hilton[1]

There are two important aspects to any chemical brush control program: An effective chemical and good application. It does not matter which is more important; you can not expect results without a full measure of both.

The need for an effective chemical is obvious. Control means complete control, including the resistant species. This can not be done with a second-rate material. Application is where many potentially good programs fail.

Too often the spraying job is given to "old Joe". Joe is a good man but can not quite handle his end of a two-man saw anymore. The spray crew seems like a nice place to put him into semi-retirement. This is wrong. Find the right place for Joe and put a trained and qualified man on the sprayer if you want results. It is a demanding job and hard work. You cannot get any more out of it than you put into it.

One of the first things we learned is that brush control is a job that can only be done effectively with chemicals. We had to cut our trees and brush when that was the best method known, but all we were doing was cultivating our problem. Cut one tree and get a dozen sprouts from the stump. We were doing the same job over year after year and not gaining on our objective.

About 1948 we tried our first major chemical control. At that time our program was to cut the rights of way and one to five days later spray the stumps to hold down resprouting. After a full growing season a water-borne foliage application was made. The second foliage application came a year or two later depending on locality, species, and general field conditions.

In 1952 we streamlined our program. At that time we started using Esteron 245, a 2,4,5-T formulation, for the stump spray and Esteron Brush Killer for foliage applications. We thought we had quite a program—and at that time we probably did, but there were still several loopholes.

Our foliage applications were not getting all of the resistant species. Our contractors would sometimes confuse their chemicals and use the foliage material on stumps or vice versa. Perhaps the worst of all was our stump treatment program. The scheme was to treat stumps after cutting; but when the cutting crew was finished, these stump cuts were covered with sawdust and loose dirt. As much as half the chemical we applied was absorbed by the sawdust and dirt and did not reach the stump. Stumps on our lines are easily covered up because we insist they be cut just as close to the ground as possible. These flush-cut stumps save a lot on tires and equipment both during construction and on maintenance.

In January, 1954, we drafted a new set of specifications. We called for 2,4,5-T for all spraying—both foliage and stump. Results improved 50 to 60 percent from that one step. We started relying on more powerful chemical with a broader range of activity and practically eliminated the human error in selecting chemicals for the specific job. After that, water-borne applications worked fine but stump treatments still were not delivering the results we wanted.

In 1955 we came up with what we think is the answer to our stump treatment problem—a basal application of 2,4,5-T in oil made prior to cutting. The chemical and oil is mixed in proportion of one gallon of chemical to 25 gallons of fuel oil. Our specifications call for the contractor to spray everything one inch or more in diameter. The application is made from knee high to the ground line with a runoff at the crown (ground line). We made our first major applications of the pre-cut basal spraying in the spring of 1955 and were able to

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judge results the following September after a full growing season. There was quite an improvement.

With the pre-cut basal application we were able to get good translocation of the chemical into the xylem and cambium layers and run-off around the crown of the tree which is all important. We got better coverage, better application and fewer misses because what we were treating was not covered up with sawdust and loose dirt. To date, we feel the pre-cut basal is the most successful program.

Our revised methods of initial clearing were so much improved that it was no longer necessary to have contractors perform initial or maintenance water-borne applications on a per acre basis. Regrowth was so far below previous levels that this method was no longer fair to us or to the contractor.

This past year we launched another phase to our present program. We call it **chemical growth control.** Chemical growth control is a knapsack application of 2,4,5-T in oil, applied by contractors on a man-hour basis rather than by the acre.

With chemical growth control, spraymen can move over the rights of way as rapidly as the growth warrants. The cost to us is in line with the density of the brush. With this method, we feel that we have arrived at a really workable and effective program.

The present method of operations for new lines is as follows:

1. Pre-cut basal application of 2,4,5-T in oil applied from knee high to the ground line with adequate run off at the ground line or crown of the tree. The chemical and oil is mixed in proportion of one gallon of chemical to 25 gallons of fuel oil.
2. Cut after 14 days minimum. (Longer is much more advantageous for greater translocation of the chemical).
3. Foliage application of 2,4,5-T in water applied after one or two growing seasons depending on species. The chemical and water is mixed in proportion of one gallon of chemical to 100 gallons of water.
4. Chemical growth control. 2,4,5-T in oil applied to vegetation from knee high to the ground line with adequate runoff at the crown or ground line. The chemical and oil is mixed in proportion of one gallon of chemical to 25 gallons of fuel oil.

Often this program can be simplified. Our results show that in many cases we can skip step three and move right into chemical growth control after cutting. There just is not enough resprouting to warrant the foliage application. You can bet that eliminating a whole step means real savings.

The contractor's spray crew making the pre-cut basal application also makes all the preliminary arrangements, such as; notifying the landowner of our intention to spray, opening of fences, clearing of the rights of way and traversing the rights of way. They also identify and mark the rights of way lines prior to the cutting crews starting their operations. This means that the cutting crew can move right into its work without any delays and the foreman directing this crew does not have to divide his attention between the cutting crew and the spray crew operations.

In 1952 we launched a program to bring all our transmission lines into condition by cutting and spraying so maintenance could be conducted with only the chemical growth control measure. At the start this was estimated to be a ten year program. Now we estimate that it will take only seven or eight years to reach this point. A lot of people share the credit for this. Everyone concerned in the program worked hard, management went along with us all the way. By the use of effective chemicals and good application our program has been shortened by two years.

When we arrive at our goal we estimate we will have cut reclearing and maintenance costs 50 to 60 percent from what they were. We cannot attribute all of this directly to chemical growth control but certainly a major share is a result of it. Because brush has been controlled effectively and there are no high stumps, many farmers, particularly in northern Indiana, are cultivating the rights of way and planting them to woods pasture. In many cases we see farmers taking out additional trees to expand this pasture. This means that our initial and maintenance clearing costs are practically eliminated in these instances as cattle will eat the young tender sprouts and retard the major part of the undergrowth.

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PROBLEMS INVOLVED IN RAILROAD VEGETATION CONTROL

Panel Discussion:—Cleston G. Parris[1], Chairman

Members of Panel:—

C. W. Bothe,[2] W. J. Cruse,[3] D. H. Yazell [4]

Summary[5]

The panel members discussed the various types of programs and the problems involved in vegetation control on their particular railway system. The problems encountered on these railroads are typical of those found in all regions of the United States.

It was mentioned that railroads use a tremendous volume of numerous materials for controlling vegetation each year. The total amount used varies with different railroads depending upon miles of track requiring treatment, weed growth influenced by environmental factors and, to a certain extent, upon traffic conditions. These chemicals and chemical combinations are used for eliminating vegetation in the ballast area on main and branch lines, controlling vegetation outside roadbed areas on the rights of way, in yard areas, around bridges, trestles, communication poles, switch stands, signals, buildings, tie and timber yards, right-of-way fences and road crossings.

The panel members briefly reviewed the reasons why their particular railroad practiced vegetation control. The reasons listed were: (1) for fire protection around bridges, trestles, buildings and communication poles or where the expense of replacement is greater than their protection, (2) to prevent fouling of the ballast, extending its life, (3) to provide maximum drainage of the ballast and roadbed, (4) to prevent locomotive slippage because of grass and weeds on top of rail—becoming more of a problem with dieselization, (5) for safety—prevent possible injury of personnel working in yards and on track, (6) to clear communication lines to avoid voltage leaks, (7) to improve sight picture at switch stands, derails, signals, etc., (8) to facilitate track inspection, (9) to prevent spread of noxious weeds, (10) to increase life of track materials, (11) to decrease tie replacement, (12) to prevent snow drifts and, (13) to improve appearance.

Among the problems encountered that were discussed were: (1) safety factors—chemical and personnel, (2) conforming to local laws, (3) consideration to be given farmers adjacent to their rights of way in regard to their crops with respect to time of application, (4) very limited supply of water now available on railroads, (5) need for proper formulations of concentrated solutions, (6) need for better designed spray equipment and its practical operation, (7) greater use of special formulas for particular weed problems on certain districts, (8) proper timing of application of contact weed killers, (9) the coordination of the application of soil sterilant type chemical in relation to certain seasonal traffic peaks as well as the timing of their application to give the best extended results, (10) the proper width of treatment—this varies according to the amount of chemical available, the ideal width where possible may be about 16-24 ft, (11) the need for developing proper equipment

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for the application of dry or pelletized materials which are now becoming available—this will require considerable experimental work on the part of railroad as well as chemical companies, and (12) brush control involving the use of improved chemical mixtures, improved spray equipment and better methods of application.

It was brought out that where the use of chemicals were temporarily restricted some railroads substituted oil sprays, weed burning and mowing as an aid in controlling vegetation.

To assist in solving some of these problems the railroads are doing considerable research work and are cooperating with various chemical companies in experimental test work. It was mentioned that a number of other things might be considered as an aid to the solution of these problems. Among those were, employment of trained personnel on a full-time basis, use of the proper type of equipment for application, proper application, because the most effective chemical is only as good as its application, and effective programming or understanding the problems in advance of work prevents serious errors or shortcomings.

After reviewing these problems it was concluded that (1) emphasis on research should develop suitable answers, (2) these answers must be available to railroads to meet their economic conditions, and (3) railroads must adopt those products available to meet their requirements.

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[2] Chemist, Maintenance of Way, Atchison, Topeka and Santa Fe Railway System.

[3] Engineer, Maintenance of Way, Great Northern Railway.

[4] Assistant Engineer, Illinois Central Railroad.

[5] Prepared by Cleston G. Parris.

THE WEED CONTROL DEMONSTRATION PROGRAM IN MICHIGAN

M. H. Erdmann[1]

Staff members at Michigan State University involved in weed control work decided during the fall and winter of 1954-55 that the educational program in weed control was not receiving adequate emphasis in Michigan. The situation at that time was as follows:

1. Several departments at the University were conducting educational work in weed control, but programs were not coordinated.
2. A limited number of weed control demonstrations were being established—primarily by extension specialists.
3. County Agricultural Agents in general were not as familiar with chemical weed control as with technical information in other fields.
4. Chemical weed control was not being widely used by Michigan farmers.

An Extension Weed Control Committee was organized to develop an effective, coordinated program for 1955. The committee representatives were from the departments of Agricultural Engineering, Botany and Plant Pathology, Farm, and Horticulture[2]. This paper is a report on the work of the Extension Weed Control Committee.

The committee decided that the most effective way to do educational work on chemical weed control, and at the same time familiarize County Agricultural Agents with the use of herbicides, was to develop a demonstration program at the county level. So in 1955 the Extension Weed Control Committee invited all County Agricultural Agents interested in establishing chemical weed control demonstrations in their counties to enroll in the program.

The committee assumed the responsibility of:

1. Supplying the agents with chemicals, plot stakes, and signs.
2. Providing a handbook on calibrating the sprayer, laying out plots, and applying the herbicides.
3. Furnishing "timely tips" and suggesting possible demonstrations.
4. Assisting the agent with weed control tours as time allowed.

The agents were asked to:

1. Purchase and use a sprayer recommended by the committee.
2. Limit demonstrations to not more than 10 different crops or weeds.
3. Supply the committee with a list of the crops and weeds selected for demonstrations.
4. Use signs furnished by the committee, to identify the weed control demonstrations.
5. Report, at the end of the season, on demonstrations conducted and assist in evaluating the program.

Participation in the program is indicated in the following table:

	1955	1956	1957
Agents enrolled	44	61	70
Active programs	36	54	*
Demonstrations	618	862	*

* Reporting and tabulation not completed

In reply to a questionnaire, the agents indicated a desire to have a training meeting dealing with weed control and the demonstration program. So winter training meetings with the agents were held at district conferences. In 1956, techniques for carrying on demonstration work were discussed along with recommendations concerning chemicals and rate of application for specific weeds and crops. In the 1957 winter meetings, current weed control recommendations were discussed.

After 3 years, we feel that the Weed Control Demonstration Program in Michigan has been successful in giving greater attention to weed control in the state. It definitely has helped to familiarize County Agricultural Agents with weed control recommendations and techniques, and it has resulted in a great deal more educational work being done in the field of weed control than was the case previous to the establishment of this program.

[1] Extension Specialist in Farm Corps, Michigan State University, East Lansing.

[2] Members of the original Extension Weed Control Committee were: R. F. Carlson, Dept. of Horticulture; B. R. Churchill, Dept. of Farm Crops; B. H. Grigsby, Dept. of Botany and Plant Pathology; L. V. Nelson, Dept. of Farm Crops; R. G. White, Dept. of Agricultural Engineering; S. K. Ries, Dept. of Horticulture, Chairman. R. F. Carlson and L. V. Nelson are no longer on the committee. M. H. Erdmann replaced L. V. Nelson as Farm Crops extension representative in 1956 and is the present chairman of the committee.

A LEAFY SPURGE ERADICATION PROGRAM

(Abstract)

H. A. Craig[1]

In formulating a leafy spurge eradication program a number of factors must be kept in mind:

1. The problem traces to the large reserves of plant food stored in their extensive root systems.

2. While thriving on a variety of soils, this weed is generally more of a problem on light sandy soils.

3. It is usually less uniformly dispersed throughout a field on non-cultivated land than annuals.

4. Its spread is accelerated under ordinary cultivation.

5. Seed scattering is an important factor in the overall program.

In setting up a program to bring leafy spurge under control, a number of underlying principles must be recognized:

1. The inability of the individual, tenant or owner, to successfully control this weed. Usually leafy spurge is found on "problem" farms operated by problem farmers.

2. The need of, and advantages accruing from, cooperative effort by municipalities or counties, Provincial or State Governments cooperating with the land owner.

3. Emphasis must be given to eradicating the scattered patches by chemical or other means.

The work in Manitoba indicates four major lines of approach as proving satisfactory. These are:

1. **Chemical**—for small and scattered patches. In Manitoba seventeen weed control units were organized, each comprised of two to eight municipalities which purchased high pressure sprayers for application of Atlacide to the small and scattered patches of leafy spurge. Atlacide has been joined but not replaced by other chlorate compounds and borax formulations in recent years. Soil sterilization by Atlacide applied at about 2½ lb per 100 sq ft, polybor-chlorate at 3 lb, and DB-Granular at 1¾ lb per 100 sq ft has in general proved very satisfactory for eradication of small patches.

The Provincial Government purchases the soil sterilant in carload lots and makes it available to the municipalities at approximately one-half cost. The Weed Unit applies the chemical without charge to the farmer. The strength of this policy I believe lies in the fact that only well qualified and experienced operators apply the chemical.

It is usually found necessary to adopt a follow-up program in which a second, but lighter, spraying is done the second year and policing of the patches followed thereafter. 2,4-D is used to advantage in grain crops to suppress the growth and weaken the spurge plants, as well as kill the seedlings. Such treatments should be made as late in the growing season as possible with due regard to the crop in which it is growing. Other workers have reported that heavy applications of 2,4-D, as much as 20 lb/A, applied on the spurge in the early bloom stage on non-crop land followed by a second treatment the following year have given nearly complete control.

2. **Intensive cultivation**—for numerous patches or extensive infestations on arable land. A program of alternating intensive cultivation with cropping over a period of five or six years has proven very satisfactory under Manitoba conditions. When a farmer for various reasons cannot cope with the problem, Municipalities are given authority under the Noxious Weeds Act to take over under lease, property declared "Weed Infested" for a period not exceeding five years to eradicate persistent perennials of which leafy spurge is the most abundant. A system of alternate intensive cultivation and cropping is followed. Revenue secured during the crop years is held in trust and at the end of the lease, any funds in excess of the expenses incurred is returned to the owner. An important factor in this method of eradication is to begin cultivation in the fall immediately the crop has been removed.

Success of the cultivation program is based on three essentials. First, cultivation must be extended over a sufficient length of time to completely starve out the root system. Second, it must be done at regular intervals, usually about every two weeks. The interval between cultivations will be somewhat longer after midsummer, due to the weakened condition of the plants. Third, a thorough job of cultivation each time. This will necessitate ample power, a cultivator in good condition equipped with sharp shovels having plenty of overlap, and a careful operator.

One or even two years of intensive cultivation will not always completely eradicate this weed with the result that some plants may appear in the growing crop. It is advisable to treat the growing crop with 2,4-D ester at maximum rates, for the variety of grain and stage of growth, to stop the spurge ripening and inhibit its growth. Both the 2,4-D treatment and early fall cultivations during the crop years, are extremely important links in the eradication process.

3. **Grazing with sheep**—for numerous patches or extensive infestations on land unsuited to intensive cultivation. Pasturing with sheep offers the best and cheapest method for control of infestation on light sandy soil unsuited for cultivation. An important factor in the success of this method of eradication is having a sufficient number of sheep confined to the infestation to insure the weed being continuously close-cropped. With proper management, sheep will make satisfactory gains, on heavily infested leafy spurge land.

4. **Keep out of cultivation.** Where large infestations are encountered on very light sandy soil likely to blow if cultivated or pastured it may be in the best interests of all concerned to quarantine the land and police the margins of the area to prevent the further spread of the weed. Some measure of control can be secured on such land, particularly if the spurge is growing in competition with native or cultivated grasses, by applying annually 2,4-D at one pound acid equivalent per acre where the spurge is in the late bloom stage.

Leafy spurge eradication poses a major problem in many provinces and states. It cannot be solved by individual effort, but must include the cooperation of State or Provincial Governments, County or Municipal Governments and the land owners on which the leafy spurge is found. Only through combined effort can we hope for success.

[1] Manitoba Department of Agriculture

TWO YEARS OF CANADA THISTLE CONTROL DEMONSTRATIONS IN OHIO 1956-1957

E. P. Reed and Gordon J. Ryder[1]

The material used, amino triazole, was supplied by the American Cyanamid Company in sufficient quantity for two ¼-acre plots in each county and was applied at the rate of 8 lb/A of 50% active ingredient material.

The instructions for establishing the demonstrations were prepared by the Extension Agronomists. In 1956, the applications were to be made when all of the thistles had emerged. However, due to a late spring, it was observed that all of the thistles had not emerged at the time of spraying. The thistle plots were to be plowed under after an interval of 2 to 3 weeks after spraying, or on fall and winter plowed land, the ground was to be thoroughly disked before planting the 1956 crop of corn or soybeans.

In 1957, the instructions were that the amino triazole was not to be applied until the tallest thistles had attained a growth of at least 8 inches. This would be better insurance that all of the thistles had emerged above the ground surface. The interval between spraying and plowing under or disking was shortened to 7 to 10 days.

The method of reporting was based on growth observations and the average number of live thistles in 3 representative one-square yard areas for both the treated and adjacent untreated one-quarter acre plots. Uniform record blanks were prepared which contained spaces for recording the date of application, the 1956 or 1957 crop grown, the gallonage of water used per acre. Forty

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and 44 demonstrations were established in 29 counties in 1956 and 1957, respectively.

Observation reports were made by the demonstrators and county agents and were submitted to the Extension Agronomists at an interval of six and eighteen months after treatment.

An analysis of the final reports on the demonstrations established in 1956 shows that 55% of the plots were sprayed before May 15 and 45% were treated between May 15 and June 15. The average height of the thistles was 7 inches with a range of 2 to 12 inches at the time of treatment. The gallonage per acre ranged from 6 to 160 with an average of 45 gallons per acre.

In eighteen months after treatment the average number of thistles per square yard in the treated areas was 2.3 compared with 14 in the untreated areas. Several observers commented that other weeds at the time of treatment had a canopy effect which prevented complete spray contact, and that all of the thistles had not emerged—thus reducing the effectiveness of control.

The cultural treatment after spraying appears to have some effect on the percentage of control. An average of 95% kill was reported on the plots which were plowed after treatment, 82% kill on plots not plowed or disked, and 73% kill on those plots which were winter plowed and disked after spraying. It appears reasonable to believe that incomplete emergence on the latter plots was partly responsible for the lower percentage of thistles killed.

The six months' observation report on the 1957 demonstrations was quite similar to the final summary for the 1956 plots. At the suggestion of the Extension Agronomists, 27% of the plots were sprayed on the thistle regrowth after the first cutting of hay. These applications were made after July 1. The average height of thistles on all plots was 9.5 inches at the time of spraying. The control, as reported on the 1957 plots, was 3.3 thistles per square yard in the treated plots as compared to 16 per square yard in the check or untreated areas. The final observations of these plots will be made in 1958.

From the results of these demonstrations, at the present time it appears that more complete control is obtained when the volume of spray is in excess of 40 gallons per acre, when the tallest thistles are 8 to 10 inches in height, when other weeds or crops do not interfere with good spray coverage, and by plowing or disturbing the root system seven to ten days after spraying.

[1] Extension Agronomists, The Ohio State University

CHEMICAL WEED CONTROL DEMONSTRATIONS IN ILLINOIS

E. C. Spurrier and F. W. Slife[1]

It is the firm conviction of Extension workers that farmers will accept new weed control chemicals and practices much faster if they can observe the effectiveness of these materials when applied under their own conditions. Farmers, as well as county extension workers, need to gain firsthand experience with the herbicides on a small scale. At the same time they also can secure practical information that is invaluable in developing new weed control practices. Farmer acceptance of chemical weed control practices depends almost entirely on how well informed they are concerning the use and feasibility of the chemical to be used. In the final analysis, it is the farm operator who will accept or reject the use of these new herbicides.

An extensive chemical weed control demonstration program has been in progress in Illinois since 1956. It has enlisted the cooperative effort of the Univesity of Illinois Agronomy Department, farm advisors, vocational agriculture instructors, chemical manufacturing companies, chemical dealers, and farmers. The program was designed to take chemical weed research out into the counties in the form of practical farm demonstrations. The objectives were: (a) to give farm operators and others interested in chemical weed control firsthand information on the use and effectiveness of newer weed control chemicals when used in their own area under actual farm conditions, (b) to better evaluate the effectiveness of chemicals when used according to recommendations under actual farm conditions over a wide area of the state, (c) to secure additional information that may be valuable from a research point of view, and (d) to encourage the use of approved weed control practices on more farms.

In 1957, 64 counties requested assistance in conducting chemical weed control demonstrations of which, due to adverse weather conditions and other reasons, 10 were unable to participate. Of the 54 counties participating, 43 were able to report results. Eleven counties initiated their programs but were unable to complete because of weather conditions. Field tests were conducted at 125 different locations in the 37 counties. At many of the locations as many as 10 different comparisons were made. These demonstrations were observed by 4,300 farmers and others interested in chemical weed control; over 1,800 of these farmers indicated their intent to use one or more of the herbicides in 1958. Over 200 news articles, 47 radio programs, 3 tapes, and 3 TV shows were prepared in connection with this demonstration program. Almost 100 percent of the participating farm advisors wish to continue the program in 1958, when several new experimental herbicides will be included for on-the-farm testing and evaluation.

In 1956, 40 percent of the farm advisors experienced difficulty when making chemical applications with farmer equipment. This fact pointed out the need for further training on the part of the farm advisor and the need for more farmer education dealing with sprays and spraying equipment. Early in 1957, 5 all-day regional training sessions were held to give advanced instruction on new sprays and on the adjustment and calibration of field sprayers. One-half day was devoted to discussing sprays and one-half day was devoted to discussing calibration and adjustment of field sprayers. Two hundred sixty-five farm advisors, farm cooperators and agricultural chemical dealers from 85 counties attended these all day clinics. The farm advisors felt that they were much better prepared to handle spray problems in 1957 than they were in 1956, and concurred that a similar program be held in 1958. In 1957 only 20 percent of the farm advisors indicated experiencing difficulty in making the applications.

Experiences with many farmers and agricultural chemical dealers indicate a crying need for farmer-dealer education on the subject of spray application. Much confusion exists at this level whenever the subject of sprayer calibration and spray application is discussed. This is another challenge for county extension personnel in behalf of the county demonstration program. The use of farm demonstrations has clearly indicated the need for this type of education.

Farmers, in general, were quite enthusiastic about the chemical weed control demonstrations. They were interested enough that farm advisers in 24 counties are planning county-wide weed eradication programs in 1958. Farm advisers held 23 field meetings in 1957 which were largely responsible for this farmer enthusiasm.

Crop yields were secured from many locations. These data lend support to the program as they indicate the economic benefits that can be derived from the use of herbicides. At nine locations, soybean yields were 21 percent higher when a pre-emergence herbicide was used. At 18 locations, corn yields were 7 to 10 percent higher because of the use of a pre-emergence herbicide. Such data are convincing evidence when farmers have to make decisions.

The county chemical weed control demonstration pro-

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gram will be continued in 1958, as it has proved to be well accepted by county workers and by farmers. The program has greatly simplified the job of informing farmers about new herbicides.

[1] University of Illinois, Urbana, Illinois

WITCHWEED: ITS CHARACTERISTICS AND THE NORTH CAROLINA SITUATION

W. G. Westmoreland[1]

In the late summer of 1956 a weed from corn fields in Columbus and Robeson Counties, North Carolina, was identified as witchweed (*Striga asiatica* L. Kuntze). Before a killing frost in November, 1956, survey teams of the USDA Plant Pest Control Division and County Farm agents in four North Carolina counties and four South Carolina counties had located various sized infestations on 117 farms.

In June, 1957, the survey was resumed and continued until mid-November. At this time, witchweed was known to occur on 1739 farms in 11 North Carolina counties and six counties in South Carolina. The counties hardest hit are Robeson, Columbus, Bladen, and Cumberland in North Carolina and Dillon and Horry in South Carolina. Farms known to have some infestation involve 81,000 acres of cultivated land with an additional 110,000 acres of pasture, wood and other land. The existing infestation is believed to be confined to a reasonably well-defined area.

The USDA Plant Pest Control Division quarantined infested areas on September 6, 1957 and quarantines by the State Department of Agriculture followed and conformed to the Federal regulations.

The Witchweed Plant: The plant is a very inconspicuous and insignificant weed in appearance. Until one becomes familiar with witchweed and its many aspects, it appears fantastic that it could be responsible for the damage attributed to it.

Witchweed is a parasitic summer annual plant. Following proper "preconditioning" with moisture and temperature the seed can be caused to germinate by a chemical stimulant exuded from the root of the host plant. Witchweed develops only a rudimentary root system which attaches itself to the host root system. After growing for three to five weeks underground the stem emerges above ground and the growing tip develops chlorophyll. It is believed that the plant continues to be dependent upon its host for mineral nutrients, water and possibly some assimilated compounds but that witchweed can perform the normal photosynthetic activities. The sessile axillary flowers begin to bloom when witchweed is four to six inches high or about three weeks after emergence. Each flower produces a capsule which can mature 500 or more almost microscopic seeds and potentially each plant can produce one-half million seeds.

Environmental Factors Involved: *Striga asiatica* is known to parasitize a large group of plants classified in the family Gramineae. Exudates from the roots of other groups of plants can bring about seed germination but these roots will not serve as hosts. Both crop plants and common widely-distributed weeds are involved.

The parasite is most abundant in deep phase sandy soils or loam soils although it is known to exist on heavy soils and clays. It is assumed that "light" soils more nearly satisfy "preconditioning" requirements and oxygen levels for the ecesis of witchweed. Soil fertility is believed to be important in affecting the development of the host root system. The plant growth is apparently favored by frequent shower activity. Probably one of most important factors is temperature. Soil temperatures of 80° F. or higher approach optimum for seed germination and parasitism and a growing season of 100+ days seems essential for the plant to produce any quantity of seed.

The Research Program: Uncovering fundamental information, checking control methods, evolving study techniques, evaluating herbicides and all other facets of the research program are a cooperative effort of the USDA Agricultural Research Service, and the Agricultural Experiment Stations of N. C. State College and of Clemson Agricultural College. Work in progress includes studies on witchweed seed viability, factors controlling seed germination and witchweed growth, witchweed and host plant growth, field plot tests, crop rotation and greenhouse studies. Research is being done to furnish answers for practical guidance to the quarantine of the Plant Pest Control Division and the individual State Departments of Agriculture. No doubt this program will be expanded and intensified as the situation warants.

The Educational Program: The witchweed educational program is not entirely formulated since much of the work involved will need to be handled as the questions arise. This appears to be very reasonable and workable because of the liaison and close working relationship of the groups concerned. The USDA Crops Protection Research Branch and Plant Pest Control Division, the State Departments of Agriculture and the Agricultural Experiment Stations and Extension Services of both N. C. State College and Clemson Agricultural College are working as an informal organization, each group aware of the work of the others.

Two different approaches must be on equal footing with each other: (1) a program to keep the general public informed on the overall problem and handling of the witchweed program; and (2) a program to aid the farmer who has a witchweed problem in understanding his problem and in adopting control procedures with eradication in mind. At the same time this program must do its utmost to enlist the cooperation of all individuals to understand the quarantine and adhere to its regulations.

The interest and cooperation of County Farm Agents, Vocational Agriculture Teachers, Soil Conservation personnel, Farmers Home Administration workers and all other groups have been excellent. It is expected that these agricultural workers will continue to be local channels for the release of research information about the witchweed plant and techniques for controlling it, and the launching of specialized efforts including quarantine information.

It is apparent that the educational program for the 1958 growing season will stress weed-free crops. The approach will be cultural and chemical control aimed at destroying witchweed plants before seeds develop and controlling the movement of all materials possibly contaminated with witchweed seed.

[1] Extension Agronmy Specialist (Weeds), N. C. State College, Raleigh, N. C.

THE IMPACT OF TELEVISION ON EDUCATIONAL MEETINGS

E. P. Sylwester[1]

Most extension specialists are very fortunate in that they have access to many means of mass communication. Every extension specialist has available to him an excellent system of news story dissemination. Very often such stories have to be prepared individually for use by one particular paper or magazine. For mass communication, however, it is advisable to write one story, send it to every county extension director, and then he can adapt it for use in his county and for use in his local papers. This ties the county extension director or county agent more closely with the extension service at the college. The insertion of local angles makes for more

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readability and interest in the article locally. Specifically, we can prepare one single news article to send to every county extension director. Through him it finds its way into the local papers. Additional news stories are prepared on request for various newspapers and magazines.

In the second place, most extension specialists have at their disposal a transcription service which ties them in quite closely with the various radio stations. Here again is a wonderful opportunity for mass education. Specifically, we here can make one transcription and it is sent to 28 radio stations in Iowa and immediately surrounding states. This gives us excellent quick coverage of any weed control material which we wish to present.

In 1950, we began to have access to television. At first it was a novelty and curiosity. There was only one station in our area, WOI-TV. We had a captive audience. There were only a small number of television sets but the number increased month by month. There were no other channels, the medium of television for mass communication was new and glamorous. You just simply had not "arrived" unless you had been on TV. But the early experimenting with this new mass medium was invaluable to give experience as to how best to present educational material.

Now, here we are approximately eight years later and television has taken its rightful place among the recognized media of mass education. We have worked most closely with WOI at Ames. There is an agricultural show at noon, six days a week, one or two different subject matter specialists appearing each day. Each specialist has about five minutes to present his material. In addition, once a week there is a one half hour show in the evening and usually two different subject matter specialists appear and have approximately ten minutes at their disposal. Actually we have access to either one of these programs or both whenever we desire. However, a schedule is usually worked out in advance to aid county extension directors. On WMT-TV we have some access to a weekly program of about six to ten minutes at noon every Friday. On WOW-TV, every Thursday, we have some access to a noon program of six to ten minutes in length. Specialists in various fields are used at WOI, WOW, and WMT. In addition, we have other stations, Sioux City, Ottumwa, Davenport, which are in the outlying areas. In these areas, many counties have regular programs. In the Sioux City area, for instance, the area covers parts of South Dakota, Nebraska, and Iowa. There are three agricultural programs a week. Seven counties in northwest Iowa participate once a week to present material of interest to their county people. The same thing is true of the other stations. If extension specialists happen to be in the areas, opportunity is usually given to present material. In central Iowa, we have two other stations, namely KRNT-TV and WHO-TV, but these no longer carry farm programs. The two stations blanket approximately the same area as does WOI-TV.

Has the advent of television affected us in our educational programs of weed control? We could sum this up very briefly by saying that the advent of television has enhanced our programs of weed control a great deal. Generally speaking, however, attendance at many meetings has gone down. There is now more competition for the leisure time of the viewer. He may come in tired from the field or office, is in no mood to go to any meeting. At the same time he has easy access to programs televised from coast to coast. All he has to do is turn on the television set. He has access to several channels and several programs. Personally speaking, the attendance at my own meetings has not gone down too much. I believe, however, that the only reason that this is true is that I have made some compensations to counteract dwindling meetings. For instance, we used to hold a lot of township weed control meetings with small groups. We also serviced a great many night school meetings as such. These were inherently small groups. One of the things which we have done to compensate for dwindling meetings is to hold no more township weed control meetings. Furthermore, all night school groups are on a county-wide basis or we do not take the assignment. I don't believe that the time will ever come when the extension specialist will travel from one TV station to another and put on his programs. There is something about a personal appearance and personal contact at a meeting which will never be replaced by television. The viewers cannot ask questions that they can at an open meeting. Consequently, personally I have as many or more meetings now as I had before but certainly cover much more territory. By limiting appearances in a county to one, we are able to service from 60 to 80 counties annually with at least one meeting or demonstration. It must be admitted that generally the coming of television has made for smaller attendance at open meetings, but I believe that we can take measures such as I have outlined to compensate for this dwindling attendance.

From letters and from comments at meetings, we know we are getting into plenty of homes and into homes of those who never go to meetings. In central Iowa, we have approximately 315,000 television sets within the range of WOI. I am sure that the same can be said of the other stations. Television sets are quite uniformly scattered throughout the entire state. They are not all going to be turned on or listening and there is of course, program competition. But, nevertheless, when one realizes into how many individual homes you can enter and present your material, it makes one realize the tremendous opportunity and responsibility that comes from such a privilege. One disadvantage of television is that the viewer cannot ask a specific question which pertains to his operation. We hear more comment on that than perhaps any other one single thing. So we try to anticipate the questions and answer them in the presentation. We try to present approximately one television show per month at Ames and additional ones to a total of approximately 20 throughout the entire state during the year. This gives good coverage of important subjects and does not become a bore to the listener.

Television is here to stay. It is a wonderful means of mass communication. It carries responsibility also in that the facts must be presented briefly, concisely and clearly. Television in its short time has become just as potent a factor in mass education as have the press and radio. We should use it and not abuse it. Correctly used it can implement all of our educational programs regardless of field of endeavor. The time of presentation is usually limited and the story must be brief, concise, and accurate. The visuals must be simple and good so that they leave a lasting picture on the minds of the listeners. The story must be told slowly, briefly, and the lesson must be simple. There is no question but that in television we have one of the most potent means of mass education at our disposal that we have ever had. Judiciously used, it can help make our work infinitely more effective and far-reaching than ever before.

[1] Extension Botanist, Iowa State College, Ames, Iowa

POLICIES FOR NOXIOUS WEED CONTROL AND BRUSH MANAGEMENT OF WISCONSIN STATE AGENCIES

H. T. Richards[1] and D. R. Peterson[2]

In each state where a noxious weed law has been enacted the responsibility for enforcing it is usually delegated to the Department of Agriculture. This department in carrying out its duties invariably meets with objections from other state agencies because of

conflicting and overlapping interests and authorities. For example, a state conservation department may have the authority and responsibility for enforcing the protection of certain flowers and shrubs and of maintaining suitable habitat for wild-life. State highway departments may have the duty and responsibility for the maintenance of state highways including the control of noxious weeds. Other state agencies also have duties and responsibilities for enforcing the noxious weed law.

Attention was focused on a situation of this nature in Wisconsin in October of 1954. The senior author received a letter requesting information on weed and brush control methods for highway rights of way. He drafted a reply and sent copies of it to the State Conservation and Highway Departments asking for comments. It soon became apparent that neither of these departments was in complete agreement with each other or with the Department of Agriculture regarding the need of or the methods to be used for noxious weed and brush control along highway rights of way. Personnel of the departments of agriculture, conservation, and highway decided it was time to bring their representatives together to discuss noxious weed control problems of mutual interest. Brush control is not a requirement of the Wisconsin noxious weed law unless a local government declares a woody plant species noxious. Because similar methods are used for both noxious weed and brush control it was apparent that brush control should be included in the discussion. Representatives of the University of Wisconsin were invited to participate because of their research end extension responsibilities in the field of weed and brush control.

It was agreed at the first meeting that it would be better for the departments represented to resolve their differences on matters of mutual interest before they became problems and the group present should be a continuing committee. As a guide for the future work of this committee and the departments it represented, it was decided that policies concerning noxious weed control and brush management should be developed and printed in bulletin form for distribution to officials and fieldmen of each department.

In the interim of three years this committee came to the attention of the Wisconsin Natural Resources Committee and was designated as a Working Group of the Land Subcommittee. Because of this action, six more state agencies which have responsibilities for noxious weed control and brush management were added to the original committee.

The addition of these six agencies to this Working Group broadened the scope of the discussions on policies. Policies were finally agreed upon and the bulletin in which they were to be printed has been developed. The principal contents of this bulletin are as follows: (1) an introduction, which describes the need for noxious weed control and brush management; (2) a page of definitions; (3) a list of the agencies concerned; (4) the legal authority of the agencies concerned; and (5) recommended procedures for establishing better noxious weed control and brush management programs.

Policies set forth in this bulletin are agreements which a group of state agencies developed and subscribed to as a basis for a closer working relationship in the future. The willingness to cooperate is quite clearly described in the final paragraph of the introduction which reads as follows, "The agencies listed on the following pages of this bulletin are willing to cooperate with local noxious weed control and brush management programs. They are legally designated to assist the public in developing programs in these fields."

The effort just described has brought together a group of state agencies which have agreed to work more closely in resolving matters of mutual interest before they become problems. Secondly, it is an effort at the state level to develop and expand a program which for many years has been the responsibility of the local governments but for which these governments have not accepted the leadership. For the future the group has established for itself the task of studying problems concerning noxious weed control and brush management and of developing recommended programs for solving these problems with maximum benefits for everyone concerned.

At this point I would like to point out examples of the type of problems with which we are concerned. The Wisconsin Department of Agriculture is interested in the control of Canada thistle. Often infestations of this weed are found growing on town roadsides and the town boards are responsible for their control. Several town boards have found that spraying with chemicals is the quickest and most economical way to control weeds and brush. Usually the practice is that of spraying all vegetation including brush or shrubs. In one instance it was reported that a town sprayer operator hedge-hopped the thistles and sprayed only the brush. This practice has been protested by the State Conservation Department. Often it is not necessary to remove several miles of brush along highways because there may be areas of brush which are not causing highway hazards and may justifiably be left standing for game cover. In many instances under communication lines it is only necessary to selectively remove the tall growing woody species while the low growing species can be left standing.

Good land use means total land use. It has been recommended that this working group establish a study area, possibly as large as a township, and put into practice as many total land use practices as possible. These would include weed control and brush management as well as other practices such as soil conservation, watershed and game management. This appears to be an ambitious program but unless all possible good land use practices are employed in an area it is difficult to say a given practice is workable or unworkable as it relates to another.

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THE IMPORTANCE OF REGULATORY WORKERS IN WEED CONTROL

Sig. Bjerken[1]

I wish to speak to you of the importance of regulatory workers in the field of weed control. As we think of weed control we must keep in mind that weed control deals not only with the eradication of weeds already established, but also with the carrying out of preventive measures through various means, such as seed inspection and the cleaning of harvesting equipment between operations.

Very little can be gained by those who cooperate in the eradication of weeds if weeds on adjacent lands are not controlled. That is where the regulatory people come into the picture. What good can come from research if the findings are not put into practice by all who have weeds? What good can come of the manufacture of chemicals and spray equipment by industry if the equipment is not used and the chemicals applied on the weeds? What good can come from the educational field through extension if the information on weed control is not put into practice by all those who have weeds? If 25% of the people do not carry out effective weed control, they through neglect largely undo what the 75% are doing who take care of their weeds. What good then can come from such a program? Since it is not within the power of the research, industry and extension peo-

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ple to influence non-cooperators I am sure we can all agree that only through legal procedure by regulatory people can a situation like this be corrected.

It is generally agreed in states where regulatory programs exist that many people are aware that if they do not control the weeds on their property legal means will be instituted to control their weeds. The majority of the people are carrying out effective weed control methods—therefore, let me raise the question—Why shouldn't the non-cooperators do likewise? In fairness to those who cooperate we as regulatory people must see that they do. As regulatory people much responsibility rests upon us as to whether a program is a success or a failure and we must at all times be conscious of this fact.

Laws are for the protection of man and property. People must be regulated in all walks of life by rules and regulations. It is not enough that 75% of the people drive on the right side of the road, nor that 75% of our children go to school, nor that 75% register for service. Law abiding citizens need not fear laws, rules and regulations. I would not want it otherwise. Let me ask you—What program has been successful if only partially carried out?

The importance of the prevention of weeds cannot be overemphasized. I am thinking of the sowing of clean seed. A man can sow enough weed infested seed in one day to take ten years to eradicate, and also in the meantime infest all adjacent lands. The inspection of seed for planting purposes by regulatory people is most important—no weed eradication program can be successful without a closely connected seed inspection program. The eradication of weeds on state, county and township highways, public utilities and railroad rights of way, state and federal lands, through the cooperation of regulatory people and those in charge is most important. The movement of screenings and weed infested material and the cleaning of harvesting equipment can only be controlled by regulatory people.

A weed program must be well organized and this responsibility rests in the hands of the regulatory people. As regulatory workers we need to meet with those responsible and one of the objectives should be to organize the program on the local level. We need to screen out the problem areas—as after all we first must know where our weed problems are located before eradication can become a reality.

Rendering service is always in order. We need to assist those who have weeds and are having difficulty, keeping in mind that through careful planning weed control measures may be incorporated into the cropping program. By so doing every acre of weed infested crop land may be cropped regardless of the seriousness of the weed provided the right crop is sowed and the proper chemical applied.

In summarizing my thoughts relative to the importance of regulatory people in weed control, it is apparent to me that there are four great forces in this field, namely Research, Extension, Industry and Regulatory. No one force can accomplish weed control without the aid of the other three and it behooves all of us to recognize the importance of each force.

In conclusion, may I say that the soil is the most important of all of our resources. We can lose our oil, minerals, etc. but soil is the most precious thing we have—from which everything must come directly or indirectly . . . everything that people eat and wear. We are going to need the soil as long as civilization exists, and it must be protected. When you consider that everything a farmer has accomplished through hard labor is invested in his farm, he is entitled to protection from enemies such as weeds, which eventually take over his land and cause him to lose his life's holding. We should all be conscious of the fact that weeds serve no purpose and that we as regulatory people are important in weed control. We have a job to do—let's do it well!

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CONTROL OF FIELD BINDWEED, BLUEWEED, AND INDIAN RUSHPEA WITH CHLORINATED BENZOIC ACIDS AND OTHER SOIL STERILIZING CHEMICALS[1]

A. F. Wiese and H. E. Rea[2]

Various soil sterilants were applied in November, 1956, to field bindweed *(Convolvulus arvensis)*, blueweed *(Helianthus ciliaris)* and Indian rushpea *(Hoffmanseggia densiflora)* growing on Pullman silty clay loam soil. The plot size was 1 square rod, and the experimental design in each case was a duplicated randomized block. The rainfall for the experimental period was approximately 18 inches. Data reported here were taken in the late summer of 1957.

Sodium tetraborate (Concentrated Borascu), sodium chlorate and 3-(*p*-chlorophenyl)-1, 1-dimethylurea (monuron) were used as check materials to compare with the new sterilants. The new chemicals tested as soil sterilants were polychlorobenzoic acids (11.4% dichloro, 29.2% trichloro, 53.2% tetrachloro and 3.9% pentachloro), 2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloropropionate (erbon), 3-(phenyl)-1,1-dimethylurea (fenuron), 7.5% 2,4-D plus sodium borate (DB Granular), propylene glycol butyl ether ester of 2-(2,4,5-trichlorophenoxy) propionic acid [2-(2,4,5-TP)] and ethanol and isopropyl series amines of 2,4-dichlorophenoxyacetic acid (2,4-D). The rates of sterilant application for each weed can be seen in Table 1.

Table 1. Control of field bindweed, blueweed and Indian rushpea with various soil sterilants

Sterilant	Pounds per square rod	Percent control		
		Field bindweed	Blue-weed	Indian rushpea
Concentrated Borascu	16	100	100	51
Sodium chlorate	5	—	99	68
Monuron	⅜	47	92	29
Polychlorobenzoic acid	⅛	96	97	9
Polychlorobenzoic acid	¼	100	100	20
Polychlorobenzoic acid	½	100	100	30
Erbon	½	94	62	—
Erbon	1	98	86	—
Erbon	2	100	97	—
Fenuron	¼	92	93	16
Fenuron	⅜	100	89	24
Fenuron	½	98	80	48
DB Granular	4	80	97	63
DB Granular	6	69	82	77
2-(2,4,5-TP) ester	¼	—	83	77
2-(2,4,5-TP) ester	½	100	100	98
2,4-D amine	¼	—	92	37
2,4-D amine	½	84	100	51
Check	0	0	0	0

In general, field bindweed and blueweed were easier to control than Indian rushpea. Eradication of bindweed was obtained with applications of Concentrated Borascu at 16, polychlorobenzoic acid at ¼ and ½, erbon at 2, fenuron at ⅜ and (2,4,5-TP) ester at ½ lb/sq rd. Blueweed was eradicated with applications of Concentrated Borascu at 16, polychlorobenzoic acid at ¼ and ½, 2-(2,4,5-TP) ester at ½ and 2,4-D amine at ½ lb/sq rd. None of the sterilants eradicated the Indian rushpea; however, 98 percent control was obtained with 2-(2,4,5-TP) ester applied at ½ lb/sq rd.

Summary and Conclusions

Results indicate that polychlorobenzoic acid, erbon, fenuron, DB Granular, and 2-(2,4,5-TP) ester may have potential use as soil-sterilizing chemicals for field bindweed and blueweed, if manufacturers can produce them cheaply enough to compete with presently available soil sterilants such as Concentrated Borascu, sodium chlorate, and monuron. Eradication of Indian rushpea

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was not obtained with any chemical tested. The most satisfactory herbicide tested on this weed was 2-(2,4,5-TP).

[1] Contribution of the Texas Agricultural Experiment Station and the Western Soil and Water Management Research Branch, Soil and Water Conservation Research Division, Approved as TAES T. A. 2802.

[2] Associate Agronomist at Bushland, and Associate Professor at College Station, Texas, respectively.

CANADA THISTLE AND PERENNIAL SOWTHISTLE CONTROL IN CROPLAND

Lyle A. Derscheid[1]

Land badly infested with Canada thistle *(Cirsium arvense L.)* was leased by South Dakota State College for the purpose of conducting research on methods of eliminating this weed. Since most of the area had a light infestation of perennial sowthistle *(Sonchus arvensis L.)*, data were taken on both weeds at the same time.

One 3-year experiment utilizing annual crops, cultivation and 2,4-D or MCPA was initiated in 1955 and an identical experiment was started in 1956. The number of plants of each species of thistles was counted on four square yard areas of each 1-rod by 3-rod plot during early June the year the experiment was initiated. Counts have been made on the same four square-yard areas of each plot during early June each year thereafter. The counts of two consecutive years are compared to determine the percentage of kill for the intervening year. Results from two years of treatments have been obtained for the 1955 experiment, but only one year's results have been obtained for the 1956 experiment.

Two replicates of forty-eight plots each were used; however, only eleven basic treatments were applied the first year. Each basic treatment was repeated four times in each replicate, making a total of eight plots in each experiment that were treated alike the first year. One treatment was repeated 8 times in each replicate. Each treatment consisted of a crop of oats that was sprayed with 2,4-D or MCPA during early June. However, different combinations of cultivation and spraying were used after harvest. All spraying was done with a specially built tractor drawn sprayer calibrated to apply 10 gallons of spray solution per acre and all cultivating was done with a field cultivator equipped with overlapping sweeps. Each plot was plowed sometime during the fall. A 2,4-D amine was applied at the rate of ¾ pound per acre on eight of the treatments, an MCPA amine at the same rate in two treatments and a 2,4-D ester at ½ pound per acre in one treatment in order to get some comparison of the various chemicals.

The result of most of the 2,4-D amine treatments are given in Table 1. These are the average results of both experiments so all figures are the average of 32 plots, except treatment 3, which contains averages of 64 plots.

Table 1. Percentage of Canada Thistle and Perennial Sowthistle Killed in One Year in Two Experiments.

Post-harvest treatment*	Per cent killed	
	Canada thistle	Sow-thistle
1. Plow 9/11	31.8	—32.6
2. ¾ lb/A 2,4-D 8/24, plow 9/11	79.4	62.8
3. Plow 8/16, cult. 9/10 & 9/27	87.6	87.8
4. Plow 8/16, ¾ lb/A 2,4-D 9/17	88.1	93.0
5. Plow 8/16, cult. 9/10, 9/27 & 10/26	83.4	90.3
6. Plow 8/16, ¾ lb/A 2,4-D 9/17, cult. 10/26	92.3	99.1

* All were sprayed with ¾ lb/A 2,4-D amine 1st wk. of June. Dates are for 1956 expt. Comparable dates for two expts are: (6/8 and 6/5), (8/11 and 8/16); (9/8 and 9/10, 9/27) and (10/15 and 10/26).

It will be observed that treatments 4 and 6 are exactly alike except that treatment 6 had an extra late fall cultivation. The difference in percentage kill is 4.2% which is probably due to this extra cultivation. This was not true for treatments 3 and 5. When all similar comparisons are made in the experiment it is observed that late fall tillage killed an average of about 10% of the Canada thistle and about 5% of the sowthistle. However, it is noticeable that late fall tillage was more effective on Canada thistle when fewer post-harvest operations were performed. For example, late fall tillage killed 22% of the Canada thistle on plots that were sprayed in the grain but had no post-harvest treatment, and 9.3% of the thistles on plots that received only one post-harvest spray treatment and no cultivation. The same was true for sowthistle except that weeds which were not treated post-harvest were not killed by late fall plowing.

When the percentage kills from plots that received exactly the same treatment, except for the chemical used, are compared, it is observed that all treatments killed between 82 and 88 per cent of the Canada thistle. These results indicate that ¾ pound of 2,4-D amine, ¾ pound MCPA and ½ pound of 2,4-D ester are about equal. There was little difference in oats yield as there was less than two bushels per acre variation between mean yields from plots treated with the three chemicals.

During the second year of the 1955 experiment 12 plots in each replicate were sprayed in the same manner as the first year, 12 were planted to corn and sprayed during late June, shortly after thistles emerged; 12 were planted to corn and sprayed twice—during late June and again in mid-August with drop nozzles; and 12 others were planted to corn, sprayed during late June, the corn cut for silage early in September and the plots plowed about one week later.

Of the stand of Canada thistle remaining at the end of the first year, corn sprayed once allowed an increase in stand of 164.6 per cent, corn sprayed twice reduced the stand 38 per cent and corn sprayed once, cut for silage and plowed killed 1.4 per cent. These are average results of the 12 plots in each of two replicates. There was little difference in the effect of 2,4-D amine, 2,4-D ester and MCPA amine on the thistles or the yield of corn.

When plots were seeded to oats and treated the second year in the same manner as the first year, treatments 1, 2, 3, 4, 5 and 6 in Table 1 killed 66, 87, 0, 48, 67 and 90 per cent of the stand remaining at the end of the first year, respectively. At the end of two years these treatments gave 77, 95, 100, 97, 99 and 98 per cent kill of the original stand.

The stand of perennial sowthistle was not dense enough during the second year to make the data reliable.

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A COMPARISON OF VOLUMES OF WATER IN APPLYING DALAPON AND ERBON TO JOHNSONGRASS (Abstract)

L. E. Anderson[1]

In Johnsongrass control studies conducted in 1955 and 1956, chemicals were applied in a water carrier using a volume of 100 gal/A. It was believed that in applying erbon (2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloropropionate) and dalapon (2,2-dichloropropionate) a thorough wetting of the foliage was essential for maximum effectiveness. Since this volume of water proved to be inconvenient from a practical point of view it was decided to study the effects of applying the chemicals in reduced

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volumes of carrier. Consequently the chemicals were applied in carrier volumes of 80, 40, and 20 gal/A. Other variables included in the study were rates and various combinations of erbon and dalapon. The applications were made to Johnsongrass plants that varied in height from 18 to 36 inches. Following are the chemicals, rates and combinations applied to square rod plots using three replications: dalapon, 15, 20 lb/A; erbon, 80 lb/A; dalapon, 10 lb + erbon, 40 lb; dalapon 5 lb + erbon, 40 lb; dalapon, 10 lb + erbon, 20 lb; and dalapon, 5 lb + erbon, 20 lb.

Treatments were evaluated approximately two months following the applications by recording the number of live culms per treated plot and comparing these values with the number of culms growing in plots receiving no treatment.

It was observed that the rapidity of kill was closely associated with carrier volume. The 40 and 20 gal. applications required a longer interval of time to attain the degree of effectiveness obtained shortly after the applications made in a carrier volume of 80 gal/A. The final degree of control as evidenced by the stand count evaluation was similar for each of the three carrier volumes included.

Since varying numbers of surviving plants existed in all of the treated plots at the time of evaluation, a second application at one-half the original rate was applied to plots in the first replication. Following retreatment, the degree of control approached 100 per cent.

[1] Kansas Agricultural Experiment Station, Manhattan, Kansas.

NEBURON AS A SELECTIVE HERBICIDE FOR TARTARY BUCKWHEAT AND WILD BUCKWHEAT

H. A. Friesen[1] and D. E. Forsberg[2]

Tartary buckwheat (*Fagopyrum tataricum* (L.) Gaertn) and wild buckwheat (*Polygonum convolvulus* L.) are annual weeds which are becoming increasing prevalent on the Canadian Prairies. Tartary buckwheat has become widespread in Alberta where an estimated 2,500,000 acres are infested. This weed has recently begun spreading into the neighboring provinces of Saskatchewan and Manitoba. Because of its size, the seed of tartary buckwheat is very difficult to remove from wheat, oats and barley and under the Canada Seeds Act grains containing it may not be sold for seed. Commercial grains containing even limited quantities of it are severely degraded.

Wild buckwheat is far more widespread than tartary buckwheat. In Saskatchewan and Manitoba it is rated second only to wild oats as the worst annual weed menace. Saskatchewan has an estimated 7,000,000, Manitoba 4,000,000, and Alberta 3,000,000 acres of its cultivated area infested with this weed. Wild buckwheat is a strong competitor with cereal grains and its twining habit of growth often causes heavy losses at harvest time.

The relative ineffectiveness of cultural methods for the control of both buckwheats stimulated an immediate interest in herbicides for this purpose. Field observations by a number of workers in Canada indicated that the phenoxy herbicides such as 2,4-D ester and 2,4-D butoxy ethanol ester give a measure of suppression of each species. However, the results have varied greatly from season to season and were often unsatisfactory, even when double applications of the herbicides were made in the same season. It is the purpose of this paper to present the results of field trials with neburon, 1-*n*-butyl-3(3,4-dichlorophenyl)-1-methylurea, an herbicide which has appeared most promising for the control of either species of buckwheat.

Neburon is a wettable powder, 18.5% active ingredient and was made available by the DuPont Co. in 1956 for trials on chickweed (*Stellaria media* (L.) Cyrillo) in lawns. In that year neburon at various rates was applied in 100 gallons of water per acre to tartary buckwheat in barley. The absolute kills of tartary buckwheat when sprayed with neburon at dosages of 3.2 lb/A or higher prompted further trials with this herbicide to establish the tolerance levels of both the weed and the grain.

Further trials were conducted in 1957 to determine the influence of such factors as: 1) growing conditions; 2) stage of development of both the weed and the crop at the time of spraying; 3) the volume of water used as a diluent and 4) the mixing of phenoxy herbicides with neburon. The excellent kills of tartary buckwheat observed in 1956 induced the initiation of similar studies with neburon for the control of wild buckwheat at the Experimental Farm, Scott, Saskatchewan, in 1957.

The experimental evidence procured from these trials has shown that neburon can be used as a selective herbicide for the post-emergence control of either tartary or wild buckwheat in cereal crops. The significant feature in favor of neburon over herbicides such as 2,4-D ester, 2,4-D butoxy ethanol ester and MCP ester was that it completely destroyed the plants, whereas the phenoxy-type herbicides resulted in a limited suppression of growth and seed setting. This latter aspect is of particular importance with tartary buckwheat, since its seeds are not tolerated in seed grain and only a very limited tolerance is permitted in the commercial grades of grain. A number of common species of annual weeds such as stinkweed, ladysthumb, lambsquarters, Russian pigweed, and Russian thistle were tolerant to post-emergence treatment with neburon. The 2,4-D ester, 2,4-D butoxyethanol ester, and MCP ester, each at 5 ounces per acre mixed readily with neburon. While the mixtures had no apparent effect on the degree of control they did tend to result in more rapid killing of the buckwheat. Moreover they afforded a good measure of control of the weed species noted to be tolerant to neburon used alone.

The data obtained would indicate that both tartary and wild buckwheat are more readily killed when treated during the early seedling stage. The trials conducted in both 1956 and 1957 point to the need for treating tartary buckwheat not later than the 4-true leaf stage. The trials carried out on wild buckwheat in 1957 would suggest that spraying could be delayed slightly longer with equally good results. The rate of application necessary for complete kills under the varied conditions sampled in these trials would be 3 lb/A of active ingredient. Under conditions of ample moisture for growth and with treatment made prior to the 4-true leaf stage the rate of neburon could be reduced to 2 lb/A.

Cereal grains treated prior to the 6-leaf stage appeared to be unharmed by post-emergence treatment with neburon at dosages as high as 4 lb/A. The tolerance of the grain is therefore well above the dosage of neburon indicated for effective buckwheat control. This is a further advantage over the 2,4-D ester and 2,4-D butoxyethanol ester when applied to grain crops at the time and rate seemingly required for control of buckwheat. With neburon applied at 6 lb/A and higher rather severe damage was noted with wheat, oats and barley. Information on the effect of neburon applied at later stages of development was not obtained.

Experimental evidence has demonstrated that 2,4-D ester and 2,4-D butoxyethanol ester can effect a measure of control of both tartary and wild buckwheat in cereal grains. However, the control is largely one of growth suppression and partial inhibition of seed setting. Complete kills have rarely been experienced at dosage levels compatible with crop yield. In contrast, neburon effectively controls buckwheat at dosage levels well below the tolerance limits of the grain crop and this control can be absolute. Thus neburon woudl appear to be the

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chemical for control of this weed. But in its present form, 18.5% wettable powder, neburon is entirely unsuited for practical field scale applications in Western Canada. At least 100 gallons of water appear necessary to provide the uniform coverage required for satisfactory buckwheat control. Cost is another important factor. Until the price is scaled to a level competitive with the phenoxy herbicides, the latter will be used for the control of buckwheats. As pointed out above, this will not result in satisfactory treatment of these weeds.

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SPRING WEED CONTROL IN THE NURSERY WITH MALEIC HYDRAZIDE

L. C. Chadwick and Bryson L. James[1]

Because of the seasonal nature of the nursery industry, control of weeds in early spring has been a major problem. Weeds are easiest to control by cultivation when they are small, which is usually at the time the nurserymen are busiest digging and shipping, and if not controlled before the rush season has passed, they become a major and a costly problem.

Maleic hydrazide was used in a nursery in March and April, 1955 and 1956 in an attempt to delay the start of growth of Taxus in early spring and thus minimize the danger of late frost injury to the young growth. It was observed that in plots treated with MH there was a very noticeable reduction in both weed growth and weed prevalence. For satisfactory control, weeds need not be completely eradicated. Merely retarding their growth during the few weeks in early spring would be extremely profitable for nurserymen. With this understanding and with the knowledge that there is very little danger of drift damage with MH, this test was undertaken to check the effectiveness of MH applied in early spring for such weed control.

Materials and Procedure. The work reported in this paper was done in the Berryhill Nursery, Springfield, Ohio, in the spring of 1957. Tests were made in six different areas of the nursery in order to include as many weed species as possible. Soil type and weed prevalence also varied from one area to another. Row crops in the various areas included *Taxus* liners, *Taxus* of B & B size, *Juniperus chinensis pfitzeriana*, newly planted *Cotoneaster* in an area seeded with rye as a fall cover crop, *Thuja* liners, and *Euonymus alatus compactus*, 12-15" size.

Plots of approximately 150 sq. ft, arranged in randomized blocks were used in all instances. Treatments with 0.0 (check), 0.5 and 0.75 per cent maleic hydrazide were replicated three times in each of the six areas. The sprays, formulated from the diethanolamine salt (MH-30), were applied with a 5-gallon Indian knapsack sprayer fitted with a 9003 Tee-jet nozzle. A 10-inch metal funnel around the nozzle directed the spray on to the ground and minimized drift to the nursery crop.

Existing weed growth was sprayed to run-off and where no weeds were visible the ground surface was wet. Prevalence of weeds at the time of treatment varied from complete coverage to less than 10 per cent in the different areas.

Treatments were applied March 30, 1957, and the temperature at the time of application ranged between 40 and 50 degrees Fahrenheit. A rain-free period of 36 hours after application was followed by two weeks of cold, rainy weather. Visual observations were made two, four, and six weeks after treatment.

Results. Two weeks after treatment there was no noticeable growth in either the treated or untreated plots, but after four and six weeks it was clearly evident that both concentrations of MH had stopped or severely retarded growth of most of the weeds treated. There was no apparent difference between 0.5 and 0.75 per cent MH treatments, therefore, the results are reported merely as treated and untreated plots.

Downy brome *(Bromus tectorum)* ("wild oats" of Ohio nurserymen) and *Anagallis arvensis*, common pimpernel, were almost completely eradicated from all treated plots, whereas, the check plots in one area were 90 to 100 per cent covered with a 15 to 18 inch growth of these weeds. *Stellaria media*, chickweed, was killed in all treated plots, and *Agropyron repens*, quackgrass, which was 3 to 4 inches when treated was only 4 to 6 inches high six weeks later, while growth in the check plots was 10 to 12 inches.

Rye, about six inches tall when treated, made no further growth in the duration of this test, while untreated plants attained a height of more than 3 feet.

Taraxacum officinalis, dandelion, was the only weed which appeared to be unaffected by MH in any of the six areas.

Discussion. Observations revealed that maleic hydrazide was especially effective for controlling chickweed, rye, common pimpernel, and downy brome. Since these were the most prevalent weeds in the check plots, and since they were either killed or their growth severely retarded for at least six weeks, control was considered very satisfactory. It is possible that dandelion, the only weed apparently unaffected by MH in these tests, had not emerged at the time of treatment.

Since, under the conditions of this test, there was no noticeable difference in the 0.5 and 0.75 per cent MH treatments, and judging from reports of other workers, it is suggested that lower concentrations may give satisfactory control of most weeds for a period of six weeks.

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A STUDY OF SPRAY TECHNIQUES TO INCREASE THE EFFECTIVENESS OF VARIOUS PRE-EMERGENCE HERBICIDES

E. C. Spurrier, W. Bowers, G. Pickard and R. Sief[1]

Farmers in Illinois are rapidly accepting the use of pre-emergence herbicides on cropland as a standard weed control practice. Band spraying appears to be a practical and a readily accepted method of applying these chemicals at planting time with equipment attached to planting equipment. Observations made in 1956 indicate that the use of inappropriate nozzles, too high pressures, and other mechanical and weather factors were responsible for many failures where pre-emergence herbicides were used. Also some simple type soil covering equipment was deemed advisable to overcome the problem of chemical loss due to volatilization and evaporation of certain chemicals—thus improving their effectiveness for weed control.

Experiments were started in 1956 and continued through 1957 to obtain information dealing with band spraying techniques and soil covering methods. The experimental areas were seeded with foxtail millet, *Setaria italica*, as the test grass. CDAA, a grass selective pre-emergence herbicide, was used as the test chemical, applied at the rate of 4 pounds in 20 gallons of water per acre in 10 inch bands across the seeded areas. Plant counts of emerging grass seedlings in the treated bands were used to compare the degree of chemical control obtained with the various spray techniques. Five experiments were conducted; the treatments were replicated four times, and most of the data subjected to

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statistical analysis. In one experiment EPTC was included as a test chemical.

The test results were summarized and the significant observations are listed as follows:

1. Pressures of 30 to 40 psi were quite satisfactory for band applications of CDAA, a pre-emergence herbicide, when nozzles capable of delivering the prescribed rate of spray material per acre were used. Pressures approaching 100 psi allowed wind drift of the spray from the band thus giving a skewed spray pattern and reduced grass control in the sprayed band. Satisfactory grass control was obtained with a gravity distribution system and this appeared to merit further consideration as a possible means of applying a band treatment.

2. A nozzle height of 10 inches above the soil surface resulted in a more desirable spray pattern than a nozzle height of 6 inches above the soil surface. Spray particles reflected from the soil surface at the 6-inch height were more subject to cross-wind drift from the treated band.

3. Shields designed to protect the spray pattern and to prevent wind drift of the spray were of little value when used with nozzles placed 10 inches above the soil surface and operated with pressures of 40 psi or under.

4. Hand covering or soil incorporation of CDAA in the treated band increased its effectiveness in controlling grass when compared to a surface application which was undisturbed. The difference in grass control was significant at the .01 level of significance.

5. Applying the spray material in a band pattern ahead of the planter and allowing the planter shoe and press wheels to mix the spray with the soil did not give satisfactory grass control.

6. When CDAA and EPTC were compared, both at a 2 pound and 4 pound rate, hand covered and uncovered, the chemical x rate interaction was significant at the .05 level indicating that there was less difference in the degree of control between the 2- and the 4-pound rate with Randox than there was between the 2- and the 4-pound rate of EPTC. The degree of control for both chemicals was increased by covering; the difference of control due to covering was significant at the .01 level. The degree of grass control was much greater between the covered and uncovered plots of EPTC than for CDAA, thus indicating that covering or some type of soil incorporation is necessary if the full effectiveness of EPTC is desired.

7. Of a number of mechanical devices designed and compared, a loop of chain dragged behind the planter press wheel appeared to do a satisfactory job of placing a thin cover of soil over the treated band. This method would tend to reduce the degree of chemical loss due to evaporation and volatilization of CDAA and EPTC and perhaps make it more effective particularly when it is applied during dry weather.

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THE INFLUENCE OF LEACHING ON THE CONTROL OF QUACKGRASS WITH DALAPON AND 2,3,6-TBA[1] (Abstract)

K. P. Buchholtz and B. G. Johnson[2]

Application of dalapon at 4 lb/A in the spring to quackgrass with a good growth of leaves usually gives satisfactory control of the quackgrass during the season. In some trials the control has been much poorer than expected. One environmental factor that has been associated with the poor control has been lack of rainfall between the date on which the chemical was applied and the date of plowing. In a few cases there was evidence that excessive rainfall may also have reduced the control obtained. Table 1 summarizes the results obtained from 14 trials with dalapon applied at 4 lb/A to quackgrass with good leaf growth.

Table 1. Effect of rainfall between treatment and plowing on control of quackgrass with dalapon at 4 lb/A

Rain—inches	Trials	No. shoots pct check
0.00	4	57 to 62
0.14 to 0.32	6	8 to 22
0.74 to 1.65	4	9 to 33

The data appear to show the necessity for rainfall during the interval between treatment and soil preparation. The rainfall presumably serves to leach the chemical into the soil surrounding the rhizomes. It is generally agreed that dalapon is translocated when the chemical is applied to leaves. The evidence is not clear as to whether translocation occurs into dormant bud tissue. If it does not, leaching of the chemical to the vicinity of the dormant buds on the rhizomes would be required in order to secure control of the weed.

The influence of the method of applying dalapon was studied in a greenhouse trial. Dalapon was applied at 2, 4 and 8 lb/A to quackgrass growing in pans. The chemical was applied to the soil only, to the foliage only with the soil shielded, and to both the soil and the foliage. The soil treatment gave the greatest reduction in the regrowth of shoots. The foliage treatment alone had the least effect while the soil and foliage treatment was intermediate. The results support the view that leaching of the dalapon into the soil is essential if regrowth of the quackgrass from dormant buds is to be reduced substantially.

The control of quackgrass obtained in field trials with a preparation predominantly 2,3,6-trichlorobenzoic acid (HC-1281-S) has also appeared to be associated with the rainfall received between treatment and plowing. In two trials poor control was secured when no rain fell during this interval. In four trials in which moderate rainfall occurred, the control was much better and averaged from 6 to 15 percent of that on check plots.

A greenhouse trial showed that the manner of applying the 2,3,6-TBA was important. The data in Table 2 show that applications made to the soil surface were much more effective than applications made to the foliage. As in the trial using dalapon the treatment made to the soil and foliage together was intermediate in its effect.

Table 2. Influence of method of treatment with 2,3,6-TBA on quackgrass shoot regrowth in the greenhouse.

Treatment	Appl. lb/A	No. shoots pct check
Soil only	1	33
	2	6
	4	1
Foliage only	1	85
	2	78
	4	46
Soil and foliage	1	47
	2	21
	4	5

Evidence from both the field and greenhouse trials indicates that incorporation of the dalapon or 2,3,6-TBA into the soil is necessary if the regrowth of the quackgrass is to be reduced effectively. This incorporation probably occurs normally by leaching from rainfall. In some instances soil preparation may serve the same purpose. The greenhouse trials gave good evidence that application of these herbicides to the foliage alone allows substantially more quackgrass regrowth to occur than if the treatment is made to the soil and leached in.

[1] Published with the approval of the Director of the Wis. Agr. Exp. Sta. as a collaborator under North Central Regional Coop. Res. Project No. 10.

[2] Dept. of Agronomy, University of Wisconsin, Madison.

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THE NATURAL BUD DORMANCY OF QUACKGRASS RHIZOMES[1] (Abstract)

B. G. Johnson and K. P. Buchholtz[2]

It is a general observation that quackgrass becomes dormant during the summer. The significance of this observation becomes more important when one realizes that the underground reproductive buds on rhizomes are also dormant. It is more difficult to evaluate the effectiveness of any chemical or cultural control practice when plants are dormant, due to the lack of rapid regrowth of unaffected parts. Therefore a more complete knowledge of the natural bud dormancy of rhizomes of this troublesome perennial weed was considered essential, and for this reason the present study was undertaken.

In a study of this nature it was necessary that a reproducible laboratory method be devised in which growth could be evaluated throughout the growing season. Preliminary investigations were conducted to determine the best method of selection and preparation of the rhizome material, the optimum conditions for growth, and a precise method of evaluating the final response. One node sections were selected and allowed to develop after imbedding in agar in flasks under controlled conditions. Since the rhizome sections that were used each contained one bud, the final response was measured in terms of the number of buds which showed activity by elongating and developing into shoots, the lengths of these shoots, and the total length and number of roots arising at the nodes. The data for each sampling date were summarized and comparisons between sampling dates were made to determine the periods of growth and dormancy.

At weekly intervals during the growing season for two years (1956 and 1957), rhizomes were taken from a heavily infested quackgrass sod and growth was evaluated. The results obtained showed that there was very good agreement in bud activity when the data from the two years were compared. In early spring the buds on rhizomes were not dormant. More than 90% of all buds planted showed activity. Between the middle of April and the first of June, the buds became dormant, showing a drop in bud activity from more than 90% to less than 5% of all planted. Bud activity remained low during the month of June. During July recovery from the dormant condition began. Recovery was slow and not nearly as sharply defined as the entrance into dormancy.

At about the time the buds on mature rhizomes began to become dormant, new rhizomes were initiated. Their growth increased so that by the beginning of July there was a sufficient amount of growth present for sampling in addition to the mature rhizomes. The buds on these new rhizomes also exhibited some dormancy, but usually not to as great a degree as did buds on mature rhizomes. Recovery of mature rhizome buds was never complete. Recovery of the new rhizome buds became nearly complete during September and variations after this time were largely due to environmental conditions prevailing. The new rhizomes overwinter and become the mature rhizomes the year following their formation. After initiating new rhizomes, the mature rhizomes deteriorate rapidly during the summer and fall months, and the few that overwinter are of little consequence the following year. The lack of complete recovery of the buds on mature, healthy appearing rhizomes that remain in the fall indicate their weakened condition.

The term "summer dormancy" does not appear to be an appropriate term in connection with quackgrass since it is usually thought of in terms of being initiated by adverse conditions of heat and drought. The month of May for both years of this study, when the buds of the rhizomes were becoming dormant, had cooler temperatures and more rainfall than normal. Also, the laboratory conditions provided, under which the buds on quackgrass rhizomes were evaluated, were optimum for growth in all respects. Thus the term "true dormancy" appears to be more appropriate since the factors causing this dormant condition appear to originate within the plant organs themselves.

[1] Published with the approval of the Director of the Wis. Agr. Exp. Sta. as a collaborator under North Central Regional Coop. Res. Project No. 10.

[2] Dept. of Agronomy, University of Wisconsin, Madison.

LIFE HISTORY OF JOHNSONGRASS PLANTS DEVELOPING FROM SEED

R. P. Schmerbauch, F. W. Slife[1]

Johnsongrass is not a new problem in the United States, having been introduced into this country as early as 1830. It has moved steadily northward and now infests the rich bottomlands of the lower Corn Belt. The seriousness of established Johnsongrass is a matter of record but little attention has been given to the growth and development of Johnsongrass seedlings.

In 1956 and 1957 Johnsongrass seed was planted on the Agronomy Farm at the University of Illinois and its growth and development characteristics were recorded.

The seeds germinate rapidly in warm, moist soils, appearing above the ground in approximately 5 days. Early seedling growth is slow and this characteristic seems to be true of most members of the sorghum family. As soon as the plants had developed 2 leaves, they were sampled and preserved in FAA solution for future study. Samples were collected at 3- or 4-day intervals so that the initiation of tillers and rhizomes could be established.

As soon as the seedlings had developed 3 leaves (2 weeks old), both tillers and rhizome primordia could be detected by cutting the seedlings. With 4 leaves, the primordia was more evident and further developed, although the rhizome primordia had not yet ruptured the lower leaf sheaths. Seedlings that had developed 4 leaves were 2½ weeks old in terms of the date of planting. Seedlings 3½ weeks old had developed 5 leaves and both rhizome and tiller initials were visible without dissection. Rhizomes were from ½" to 1" long. Most of the rhizomes at this stage were horizontal to the ground rather than vertical. Beginning with the 5-leaf stage, the Johnsongrass plants developed very rapidly. New rhizomes were initiated and many of these made vertical rather than horizontal growth. Plants 6 weeks old were from 30" to 36" tall and at 8 weeks plants had reached heights of 4 to 5 feet.

The rhizomes on plants developing from seed seemed to have no bud dormancy when removed from the plant. They grew normally. Seventy days after planting, the Johnsongrass plants were producing seed. These plants could not be distinguished from plants that had developed from old rootstocks.

This study indicates that perhaps the major problem in Johnsongrass is a seedling problem. Destruction of the old plants is a temporary control measure because of the rapid growth of seedlings.

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CRABGRASS CONTROL IN BLUEGRASS[1]

R. W. Campbell[2] and L. R. Quinlan[3]

Experiments were conducted at Kansas State College during the summers of 1956 and 1957 to determine the effectiveness of various herbicides for crabgrass (*Digitaria sanguinalis* and *D. ischaemum*) control. The blue-

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grass turf was on the campus at Manhattan and was heavily infested with both crabgrass species.

In 1956 the average temperature was above normal for the entire spring and summer, and rainfall was below normal. The summer temperatures in 1957 were nearly normal with total rainfall slightly above normal. Sprinkler irrigation was utilized as needed both years.

1956 Studies

Three experiments were conducted in 1956 which included pre-emergence applications, two- to three-leaf stage applications and a combination of the two treatments. The spray materials were applied with a knapsack sprayer at a rate of 40 gal/A. Alanap 1-F was spread by hand. All plots contained 25 sq ft and each treatment was replicated 3 times. The degree of control was estimated by sampling 1 sq ft areas of each plot. Treatments and results are indicated in Table 1.

The only material that gave good control of crabgrass throughout the germinating period was PAX; however, the bluegrass stand was only medium to weak.

Both PMAS and Methar gave good control of crabgrass when applied in the two- to three-leaf stage of growth. The bluegrass in the plots receiving PMAS showed no injury while some temporary discoloration to the bluegrass was noted in the Methar treated plots.

The combination application of chlordane and Methar gave nearly perfect control of crabgrass and the bluegrass was very vigorous. The PAX and Cyanamid treatments also gave complete control of crabgrass and the condition of the bluegrass was fair.

1957 Studies

The plots were 25 square feet and each chemical treatment was replicated four times. The degree of control was determined by counting the seedlings in a 1 sq ft area of each replicate. Counts of hairy and smooth crabgrass were taken separately. Three tests were made, including pre-emergence applications, two- to three-leaf stage applications and mature seedling applications. Treatments and results are indicated in Tables 2 and 3.

None of the pre-emergence applications were outstanding in the control of the crabgrass seedlings although PAX, chlordane, sesone + chlordane, lead arsenate at 10 lb/A, Alanap 1-F and neburon all gave considerable reduction in the number of seedlings of both species. Simazin at 2 and 4 lb/A killed all vegetation in the plots to which it was applied. Six months later bluegrass seeds failed to germinate when planted in the Simazin-treated plots. None of the other chemicals appeared to injure the bluegrass.

All of the chemicals applied at the two- to three-leaf stage greatly reduced the number of hairy crabgrass seedlings. This was true also for smooth crabgrass seedlings except for plots sprayed with chlordane. There was no visible injury to the bluegrass from any treatment other than a very slight temporary discoloration.

Methar, PMAS and PM 2,4-D applied to mature crabgrass seedlings greatly reduced the number of live smooth crabgrass seedlings.

It was obvious from the check plot data that the population of common crabgrass seedlings was considerably smaller than that of the smooth seedlings.

Table 1. Crabgrass control in bluegrass—1956
Data taken October 13

A. Pre-emergence applications, made May 24, June 19 and July 5

Chemical	Rate/1000 square feet	Condition of bluegrass	Est'd percent crabgrass av. of 3 replications
1 Sesone	5 tbsp.	Fair to weak	80
2 Neburon	4 to 8 oz.	Weak	75
3 Alanap 1-F	18 lb.	Moderate	85
4 Chlordane 45%	½ pt.	Moderate	55
5 PAX	25 lb.	Mod. to weak	Trace
6 Check	6 plots	Weak	95

B. Two to three leaf stage applications, made June 6, June 20 and August 3

7 KOCN	3 oz.	Fair to weak	60
8 PMAS 10%	2½ oz.	Vigorous	7
9 Methar	2.7 oz.	Mod. vigorous	8
10 Cyanamid	3 lb.	Weak	90

C. Combined pre-emergence and two to three leaf stage applications**

1 plus 7—Sesone and KOCN	Mod. to weak	32
2 plus 8—Neburon and PMAS	Vig. to fair	19
4 plus 9—Chlordane and Methar	Very vigorous	0
5 plus 10—PAX and Cyanamid	Fair	0

**Chemicals applied at rates listed in Sections A and B.

Table 2. Crabgrass control in bluegrass by pre-emergence materials—1957

Chemical	Rate	Av. No. crabgrass seedlings in 1 sq ft August 15-16 Hairy	Smooth
Applied April 25, May 27 and July 1.			
1. Alanap 1-F	800 lb/A	0	118
2. Sesone	3 lb/A	90	210
3. Chlordane	½ pt/1000 sq ft	31	94
4. Sesone + chlordane	2 + 3	62	14
5. 3Y9	2 gal/A	107	153
6. ACP M-307	1 lb/A	146	33
7. ACP M-307	2 lb/A	105	9
8. ACP M-307	3 lb/A	163	38
9. Simazin	1 lb/A	19	9
10. Simazin	2 lb/A	0	0
11. Simazin	4 lb/A	0	0
Applied April 25			
12. PAX	25 lb/1000 sq ft	28	13
13. Lead arsenate	10 lb/1000 sq ft	25	58
14. Lead arsenate	20 lb/1000 sq ft	109	35
15. EPTC	3 lb/A	88	99
16. Neburon	4 lb/A	79	181
17. Check		187	326

Table 3. Crabgrass control in bluegrass—1957

Chemical	Rate	Av. No. crabgrass seedlings in 1 sq ft Hairy	Smooth
Applied at two- to three-leaf stage, June 10, 18, and 26. Counts Aug. 15-16			
1. Chlordane	½ pt/1000 sq. ft.	22	484
2. PMAS	2½ oz/1000 sq. ft.	42	2
3. PM 2,4-D	3 oz/1000 sq. ft.	17	8
4. DSMA (Weedone liquid)	3 oz/ 400 sq. ft.	0	0
5. DSMA (Weedone dry)	13 lb/4000 sq. ft.	3	10
6. DSMA (Methar 30)	1 pt/3000 sq. ft.	1	0
7. DSMA (Methar 80)	1 lb/6000 sq. ft.	.5	0
8. Check .		187	326
Applied to mature seedlings, Aug. 2 and Aug. 10. Counts Aug. 27			
9. DSMA (Weedone dry)	13 lb/4000 sq. ft.	2	147
10. DSMA (Methar 30)	1 pt/3000 sq. ft.	0	0
11. Chlordane	1 pt/1000 sq. ft.	0	442
12. Check		43	648
13. PM 2,4-D	3 oz/1000 sq. ft.	13	20
14. PMAS	3 oz/1000 sq. ft.	6	18

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RESULTS OF SOME EXPERIMENTS IN THE CONTROL OF CERTAIN AQUATIC WEEDS IN MISSOURI FARM PONDS (Abstract)

Charles R. Walker[1]

The control of submersed aquatic weeds is a major problem in the management of Missouri fish ponds. Dense stands of aquatic vegetation in ponds have re-

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peatedly caused serious crowding and stunting of fish populations. Recreational values have been impaired by the physical interference of weeds with fishing and boating. Even more serious are the occasional partial or complete kills of fish populations caused by oxygen depletion as plants decay. These kills may occur either in summer or winter.

Fertilization of ponds to increase fish production frequently has had the undesirable side effect of stimulating the growth of aquatic weeds. Several new herbicides and algacides have been tested in the search for weed control techniques. The use of a new water soluble fertilizer holds the promise of increasing fish production and of controlling certain submersed weeds. Plants which this fertilizer has controlled in experimental ponds include pondweeds, muskgrass, water hyssop and some filamentous algae.

Laboratory screening tests of new aquatic herbicides are useful in determining their toxicity to fish, but it is necessary to test them under field conditions to prove that they are effective for aquatic plant control. The field tests are complicated by marked variations in fertility and biota even among ponds which lie side-by-side on the same water shed. Methods have been devised to aid in overcoming the difficulties of plot replication and control brought about by these differences. One useful new technique is that of dividing a pond in half with a vinyl plastic curtain. This provides an effective chemical and physical barrier between the two halves of the same pond. The advantages afforded by this technique are obvious. Another even more useful application of plastic curtains is that of constructing small enclosures which allow plot replication even in limited stands of a particular plant. These enclosures are made along the shore, using two stakes at the outer edge of of the plot, and suspending the plastic sheet from styrofoam floats.

Simazin (2-chloro-4,6-bis-(ethylamino)-*s*-triazine) pellets containing 10 percent active ingredient showed promise as a herbicide in the control of problem species of aquatics. Toxicity experiments proved this material was not toxic to several species of fish and fish food organisms in soil sterilizing concentrations.

[1] Biochemist, Fisheries Section, Missouri Conservation Commission.

AQUATIC WEEDS IN KENTUCKY AND PRELIMINARY RESEARCH WITH CERTAIN HERBICIDES USED FOR THEIR CONTROL

(Abstract)

Charles C. Bowers, Jr.[1]

Kentucky has approximately 150,000 small lakes and farm ponds within its borders. These lakes and ponds are usually quite fertile, relative shallow, and are highly susceptible to aquatic weed invasions.

Warm water fishes in these bodies of water have a high reproductive capacity which in Kentucky's warm spring and summer months is exercised fully. Aquatic weeds protect this abundant spawn from the thinning action of normal predation by the larger fishes creating overcrowding and subsequent stunting of the fishes in a very short time. Aquatic weeds present an obstacle to fishermen and an unpleasant view to those seeking aesthetic pleasure from small lakes and ponds.

For these reasons the Kentucky Department of Fish and Wildlife Resources views all aquatic weeds as nuisances as far as fish and fishing are concerned and deems complete elimination of underwater and floating aquatics as desirable.

The Department has instituted a weed control program on a moderate scale. State personnel control aquatic weeds in and on state-owned lakes, provide equipment and supervision for the larger private and municipal lake weed control operations and give instructions and advice to small lake and pond owners.

The chemical most often used for underwater aquatic weeds has been sodium arsenite. It is relatively inexpensive; it does not kill fish (at weed killing concentrations); it is effective on most underwater weeds; it is relatively simple to apply; and the pond or lake does not have to be drained for its use. Sodium arsenite has advantages, but it is quite dangerous to use, and it requires a quarantine of the treated water for at least two weeks.

Two spray operators suffered arsenic poisoning from four weeks of spraying with several thousand gallons of sodium arsenite, in spite of elaborate safety precautions. Approximately fifty small lake treatments with sodium arsenite have been made in Kentucky since 1954.

Kentucky wishes to replace sodium arsenite with a safer chemical for underwater weeds. To this end, samples of Kuron (contains erbon) and Radapon (contains dalapon), provided by Dow Chemical Company, were tested on mature stands of several aquatic weeds.

A one acre (1.14 acres) lake containing a solid coverage of leafy pondweed, *Potamogeton foliosus*, was used to test Kuron. Two bays on the lake were measured and staked to contain one-tenth acre each. One bay averaged 2.5 feet in depth with four foot maximum. The other bay averaged 4 feet deep with a seven foot maximum.

Each bay was treated with Kuron sprayed on the surface at one gallon per surface acre on June 19, 1957. Definite results were not noticed until ten days had passed. At that time a definite line could be seen at the outer limits of both bays with a 50% kill in the areas. After three weeks approximately 85% kill was noted. No difference in the kill in the two bays was noted.

On August 9th the whole pond (greatest depth, nine feet) was treated with one gallon of Kuron. By August 19 no living weeds could be found; however, in another pond on the same farm leafy pondweed died naturally weeks later.

Kuron was sprayed (three quarts per 100 gallons water) on an infestation of water primrose, *Jussiaea diffusa*, a floating aquatic, and achieved a 100% kill in two days.

Duckweed, *Lemna* sp., was sprayed at the rate of one gallon per surface acre twice, two weeks apart, resulting in a good kill on the weed touched by spray, but wind piled the plants to many thicknesses so that only the top plants were killed, leaving a portion that soon covered the pond again.

Kuron killed bluegill in an aquarium when used at the rate of one gallon per three acre feet of water. The fish died after 20 hours. No fish died in any of the test ponds when approximately the same concentrations were used. Fish in the Kuron test ponds acquired an unpleasant oily taste which persisted at least three weeks following treatment. It is thought here the carrier was responsible.

Radapon, a dalapon chemical, was used on two test ponds and a thirty-three acre lake. The two test ponds sprayed with Radapon at the rate of 20 pounds per 100 gallons of water in two applications five weeks apart to eliminate cattails, spike rush and several other rushes. The first treatment left a few plants untreated but the second completed the kill of these and the small amount of regrowth.

On the thirty-three acre lake a fringe of cattails five to fifteen feet wide was divided into five treatment areas 150 to 200 yards long. Five sprays were tried attempting to get one that would get a 100% kill with no regrowth: two and one-half quarts of 40% 2,4-D ester in 25 gallons Diesel fuel and one pint of Tide detergent; 30 pounds of Radapon in 100 gallons water sprayed in two applications same day; two and one-half quarts 40% 2,4-D ester and eight pounds TCA-90 in 30 gallons kero-

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sene; 20 pounds Radapon and one and one-half quarts 40% 2,4-D ester in 50 gallons water; and 15 pounds Radapon and two quarts 40% 2,4-D ester in 50 gallons water. The 20 pounds of Radapon and one and one-half quarts of 2,4-D resulted in 100% initial kill and no regrowth. All other sprays resulted in either incomplete kills or allowed regrowth.

The Kentucky Department of Fish and Wildlife Resources tests indicate that Kuron is a promising new chemical on underwater and floating aquatics and Radapon is the best chemical so far tested on cattails. The addition of 2,4-D to the Radapon mixture appeared to prevent regrowth of cattails.

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FURTHER OBSERVATIONS ON THE USE OF PELLETED HERBICIDES FOR THE CONTROL OF AQUATIC WEEDS (Abstract)[1]

Buford H. Grigsby[2]

The use of granular herbicides, first reported at the 1956 NCWCC, was continued in 1957 and extended to include applications made in open water and to include other species of submerged weeds and several species of green and bluegreen algae.

Experimental lots of herbicides suspended on Attaclay, bentonite, or Vermiculite were secured and applied in April and August at two locations in Michigan. The rate of application generally was at 20 and 40 pounds per acre of active ingredient. A 10 percent formulation on the inert carrier gave sufficient bulk to permit uniform application from a small boat propelled by an out-board motor.

The following herbicides were used: 2,4-D (unformulated ester), diuron, CDEC, ATA, polychlorobenzoic acids (ester), 2,4-D (pure acid), endothal, fenuron. The weeds present in the treated areas, 50 x 50 ft., were: *Potomageton* sp., *Myriophyllum* sp., *Najas* sp., *Ceratophyllum* sp., *Vallisneria* sp., and *Heteranthera* sp. The algae included a number of unidentified unicellular green and blue-green forms as well as filamentous forms of these two groups. All treatments of algae were made in 15 gallon tanks kept in a greenhouse.

Results from the applications on rooted aquatic species showed that unformulated esters of 2,4-D, silvex, and polychlorobenzoic acids were more effective on these weeds than were the other herbicides. Seasonal control on all species except *Heteranthera* and *Vallisneria* was obtained with each of the herbicides. The applications made in August were especially effective because the treatment was made at the time when vegtative propagation of these species was at a peak.

In the experiments with algae concentrations of 10, 20 and 40 ppm were used and the results were as follows:

	Percent kill at conc. ppm		
Herbicide	10	20	40
Silvex	100	100	100
Diuron	100	100	100
Simazin	100	100	100
Phygon (on charcoal)	100	100	100
ATA	90	100	100
Fenuron	75	75	100
CDEC	50	100	100
Endothal	0	0	0

These results suggest that granular herbicides, in a wide range of chemical formulations, are effective algacides where the nature of the infestation will permit a suitable contact period or an actual water concentration in the range of 20-40 ppm.

The data secured in these experiments suggest that the use of granular herbicides is a feasible method for the control of algae and rooted aquatic plants. The prime requisites for such herbicides appear to be:

1. Low solubility in water
2. Particle size which will facilitate deposit of the formulation on the lake bottom at the desired rate
3. Slow release of active ingredient from the carrier
4. Application timed to coincide with most rapid development of root system.

The two most promising herbicides are 2,4-D ester for rooted aquatics, and Simazin for algae.

[1] This abstract is submitted with the approval of the Director of the Michigan Agricultural Experiment Station.

[2] Department of Botany and Plant Pathology, Michigan State University.

SINGLE STEM TREATMENTS FOR BRUSH AND TREE CONTROL (Abstract)[1]

A. M. Davis[1]

A series of plots using continuous axe frill, interrupted frill, basal bark and injector methods of application were established in late December, 1955. Materials used were 2,4,5-T, 2-(2,4,5-TP), 2,4-D-2,4,5-T, and 2,3,6-TBA.

Concentrations of 1 lb/gal, acid equivalent, in kerosene gave no kills from basal bark, interrupted frill, or injector except 2,4,5-T and 2,3,6-TBA. The axe frill killed the top of all trees; root sprouts were inhibited only by 2,4,5-T. Profuse sprouting accrued with TBA. Two seasons later leaves on these sprouts were malformed and partly discolored but still alive. No plots were killed by 2-(2,4,5-TP). The most effective single treatment was 2,3,6-TBA injected into the base of trees; all trees injected were killed.

A similar set of plots was established in August of the next summer. Here the most effective treatment was 2,4,5-T in the injector. TBA used on sassafrass killed all the above-ground parts but a profusion of root sprouts developed.

For summer treatments 2,4,5-T was the most successful. For winter treatment with the injector 2,3,6-TBA was the most effective. For girdle spraying, 2,4,5-T was more generally effective in inhibiting root sprouts. This was in direct relationship to the height of frill. The lower the frill, the more root sprout supression.

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BRUSH AND TREE CONTROL WITH AN INJECTOR

by Reuel W. Little[1]

Since the turn of the century the "worthless brush and trees" have been on the march. With only a few acres of mesquite in Texas at that time, it now infests over 35 million acres in Texas alone. Overgrazing and droughts that caused the turf to thin provided seeding ground for mesquite as well as other types of brush and trees throughout the pastures and range lands in the United States and Canada. Also abandoned formerly

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cultivated fields have been a good seedbed for the spreading of these trees of very low commercial value.

Then, in our forests, the pine and fir and other softwoods have been cut and the cull trees and hardwoods have taken over. On millions of acres the softwood trees are almost, if not, extinct. The need for a better tool to control or eliminate unwanted trees and brush is great.

In designing the tree injector, our approach was simple. The big problem was a tool that in applying the herbicide, would kill the root system as well as the above ground part of the tree. This is the thought I had in mind in designing the tree injector. The only living part of the tree is the sap-wood. In this area is the cambium. The outer bark and the center of trees are of very little value in the life of a tree. I started in to design a tool that would make a pocket in the live wood into which could be released the herbicide so it would circulate down to the roots and up to the leaves. Of course, the most effective place to put the chemical is in the circulatory system of the tree. In foliage spray, the leaves, the fighters and feeders of the tree, will carry the herbicide into the circulatory system of the tree. With basal spray, the herbicide must soak through the outer-bark and into the cambium to be moved through the tree.

In frills with an axe the herbicide is placed in the cambium and moves into the circulatory system of the tree.

With an injector, you throw the cutting-bit through the outer-bark into the cambium wood and form a pocket and release the chemical. The injection is made in the base of the tree near the soil. This chemical in the pocket is directly in contact with the circulatory system of the tree. It may move to the roots and up to the leaves. It is the chemical that kills the tree. For most hard wood the 2,4,5-T ester has given best results. Our suggestion is to use 3 pints of 2,4,5-T ester (4 pounds of acid per gallon) in 4 gallons and 5 pints of either diesel fuel or kerosene. In the summer months of July, August and September water substituted for diesel or kerosene has produced good kills.

The injector has these distinct advantages:

1. It is a comparatively safe tool. With proper operation of the injection it is almost impossible for a workman to injure himself or others.
2. It may be used any time of the year.
3. Not over 3 per cent resprouts.
4. Capital investment of injection is small, being only $50.00.
5. No damage to crops from spray drift.
6. Injections are easy to make at soil line.
7. Easy to learn how to inject.
8. Since chemical goes directly into circulatory system of tree, your chemical cost is only 1/6 of basal spray; ⅛ of foliage spray; and ½ of frilling with axe and spraying.
9. Labor cost is low. Good workmen on average timber area can do two to three acres a day.
10. Total cost per acre on average is only about $6.00 per acre.
11. It is selective and you may leave any tree you desire for shade or fruit or any other purpose.

The injector has many uses. One of the most important is in improving pasture and range lands. First you kill the trees one inch to one and one-half inch in diameter and up. Do not graze treated area from May 10 to November 1 for at least two years. However, livestock on land from November 1 until May 10 will help scatter seed from the grass that comes up in the areas. The land is fertile because of the decayed leaves and the grass quickly takes over.

If there is undergrowth, do not bother the species smaller than one inch in diameter because it will be expensive. The small undergrowth will be subject to the following hazards and at least 50 per cent will be killed:

1. In dense stands some of the plants will be killed due to competition.
2. Cattle, especially older ones, will eat part of small brush.
3. Some may be controlled by burning.
4. A dense stand of grass will prevent seedling development of woody plants.

The survivors, when they reach one inch to one and one-half inch in diameter and larger, should be injected.

Goats are good for control of undergrowth. Brush one inch in diameter that will produce one pound of leaves in June if properly handled may produce about 20 lb of leaves before being killed when grazed by goats and also 6 lb of fertilizer will be produced. This is very helpful to your soil. Angora goats are considered best.

The important thing to remember is that immediate land improvement may be expected. Grass production may be increased from one to ten times.

The injector method is also valuable for clearing land to be put in cultivation.

First inject the trees near the soil. Then wait until it has gone through two summers. The top above the ground will rot and deteriorate faster than the part below the ground. A bull-dozer with ram constructed so it will hit the tree about 8 to 10 feet above the ground may easily push over the deadened tree. The roots are still in the ground. After burning the brush level the soil and disc and re-disc and sow to small grain.

If row-cropping is desired plant small grain or cane for two years and then the roots will be in such a condition that the land can be plowed with a disc plow and prepared for intensive cultivation. Using this method, costs will be only about 25 per cent that of other methods.

The injection method is being extensively used in timber stands. It is selective and the hardwoods may be killed that are suppressing the softwood trees thus, release them so they may take over. The United States Forest Service to date has purchased 657 injectors and is successfully using them.

The injection method is being used to clear right-of-ways for telephone and light and power lines, roadways and highways and railroad right-of-ways. The cost is only about 50 per cent of spraying and the kill much better.

[1] Reuel Little Tree Injection Company, Madill, Oklahoma.

A METHOD OF DETERMINING THE MINIMUM AMOUNTS OF HERBICIDES NEEDED FOR AERIAL BRUSH CONTROL (Abstract)

Eugene I. Roe[1]

Because of its rapid and low-cost application, aerial control of undesirable woody plants by means of foliage sprays has great appeal to foresters. Little research basis exists. The work being done is mostly on a trial-and-error basis. Before it can have a solid foundation, the minimum amount of herbicide (both in acid equivalent and volume of solution) to control a unit-area of brush of a given density must be worked out for each common species. Special equipment has been developed and is being used to determine these standards for hazel and mountain maple in Minnesota. Equipment and methods which are applicable to other species of medium-sized brush elsewhere are described in detail.

[1] Lake States Forest Experiment Station, maintained by the Forest Service, U. S. Department of Agriculture, at St. Paul, Minnesota, in cooperation with the University of Minnesota.

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BROOMWEED INVASION AND CONTROL IN NATIVE GRASS PASTURES AND RANGELAND, CENTRAL OKLAHOMA, 1957[1]

Harry M. Elwell [2]

Broomweed *(Gutierrezia dracunculoides)* invaded a high percentage of native grassland in central Oklahoma during the growing season of 1957. On many areas, stands of this weed were moderate to heavy by mid-June. Favorable temperatures and above-average rainfall following four years of moderate to severe drought favored rapid and early invasion of areas where overgrazing had reduced the grass cover and broomweed had little competition because of intense grazing.

Broomweed is an annual, reproducing by seed. It has a shallow tap root with many fibrous branches. The above-ground part is a slender, erect stem with a bushy top 15 to 30 inches tall. The leaves are small, about 1 inch long and ⅛ inch wide. Dense stands of broomweed produce considerable shade and competition for native bluestems, Indian grass, switch grass, the blue, hairy and side-oats gramas, and buffalo grass, particularly where moderately to heavily grazed. Livestock do not noticeably browse on broomweed. Neither do rodents or insects appear to feed on it.

For determination of yields of this weed, several random samples were taken in each of a number of pastures or ranges. The pastures were representative of various sites, including valleys, upland, and shallow, soil areas. The samples were taken from pastures where the number of livestock per acre would not have been excessive if the land had produced an average yield of grass. They were taken during the latter part of August, the time when native grasses are usually taken for hay. Broomweed was producing an average of 2,364 pounds per acre (oven-dry weight). An average of only 490 pounds per acre of grass was left. Normally, about 500 to 1,000 pounds per acre of grass residue should be left for soil protection.

Grassland not grazed from May 1 to October 15 was producing an average (oven-dry weight) of 2,474 pounds of grass and 537 pounds of weeds per acre.

Native grasses when given a chance will produce the maximum forage obtainable from the land. Deferment is a good practice for control of weeds. On grassland areas where weed invasion is heavy, but the stand of grasses good, two years deferment generally will eliminate many annual weeds and control some of the perennial ones.

Broomweed except in early stages of growth is resistant to 2,4-D. It can be controlled by treatment with about 1 pound per acre equivalent of an ester formulation of 2,4-D, applied during the latter part of May or early June. Treatment during this period will usually also kill or control many of the other weeds in native grass pastures. However, reduction of broadleaf weeds with herbicides should be accompanied by improved grazing management to favor recovery of desirable perennial grasses; otherwise annual weed grasses are favored and will infest the area.

Mowing will control many broadleaf weeds, especially broomweed. However, mowing without deferred grazing will not maintain the native grasses.

There is a critical need for additional research and extension programs to develop more effective methods for maintenance of native grasses on range and pasture land in Oklahoma.

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[1] Approved November 27 for presentation at the North Central Weed Control Conference, Des Moines, Iowa, December 11, 1957.

[2] Research Agronomist, Crops Research Division, Agricultural Research Service, USDA, in cooperation with Oklahoma Agricultural Experiment Station.

HOW TO GAIN INTER-AGENCIES' COORDINATION AND COOPERATION IN COUNTY WEED CONTROL

John R. Reid [1]

The dictionary describes cooperation as the art of working *together* or jointly. Obviously there can be no cooperation unless *you do your* full share of the job. It has aptly been said that you must first *be* a friend before you can have friends; so it is with cooperation. What must *you* have to cooperate?

First, you must have a real desire and enthusiasm for the job. If you do not have this, quit and get work you do like. Second, you must have the ability to get along with people and organizations.

Whom must you get along with? First of all, the Board that appoints you, then your deputies or assistants, your Extension Director, Farm Bureau, public utilities, county maintenance men, the newspapers, and of course the public in general.

How do you go about getting the job done? Here again the first thing you must do is have a down-to-earth discussion with your Board, find out how far they want you to go in control measures, and how far they will go in backing you up. If they won't go all of the way with you, you may as well give up and go home right away. Once you have the "go ahead," quit bothering them with your problems and go out and do the job; they have plenty of headaches of their own.

With your county extension director, use him freely but with discretion. Once he has identified a weed or plant, advised you on a problem of control, learn the solution well; he is a busy man and may resent your coming back with the same problems. Remember this, however, he is the direct route to an agency that can really give you the latest answers. Weed control in most counties really began only some ten years ago, but the Extension Service has been the "voice crying in the wilderness" for many, many years. *You* are one of those who can help them get the message across; *you* must have their help. In all cases of assistance, remember to show your appreciation; nothing is more conducive to cooperation than a proper esteem for the help you get.

Your farm organizations, like the Farm Bureau, can be a powerful influence in weed control; after all, in Iowa they had a big part in convincing the State Legislature that we needed real weed control. Go to your influential Bureau members, if they are violators; insist on their compliance and ask for their help among their neighbors. In the development stage of your program, get yourself invited to group meetings, explain your duties, ask for questions, and talk weed control at every opportunity.

Your county road employees and your township officials can be a real help to you, if you show the right approach. Here a word of caution is in order: In all cases where knowledge of violators has been given you, *never* divulge your source of information. Let the public feel secure in being able to come to you without fear that individuals will become involved. Weed control is *your* responsibility; don't try to shift it on anyone else. Get all the information and assistance from all agencies that you can, but assume all of the load of enforcement yourself. If people get the idea you are using them for things you should do yourself, you will soon be left "high and dry" without help.

Your public utilities can be a big help to you on roadside improvement. In our county we cooperate fully; where they cut brush and trees, we treat the stumps. They in turn do spraying that benefits both them and the county. In felling large trees along their lines, they are ready and anxious to be present to prevent damage or interruption to their service.

Finally, there remains at least one more source of

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help to all of you; that is the newspapers. They, too, are ready and anxious to help, they will use a constant supply of information fed to them by you. Be sure your data is correct, timely, and in the public interest.

In summary then, to get the job done, you must have the support of those back of you, you must want to do the kind of work it takes, and you must continue learning. You must be tolerant of other people's opinions, humble, and appreciative to those who can help you. You must acquire the reputation of being strict but absolutely fair in your dealings with everyone; and above all you must realize that a perfect state of weed control is a long way off, but you must never stop trying for it.

[1] County Weed Commissioner, Tama County, Iowa.

HOW TO INVOLVE ALL FARMERS IN A COUNTY WEED PROGRAM

Glenn L. Schrader [1]

One of the first steps taken in developing and involving people in the weed program in the Minnehaha County, was the developing of interest and establishing a need for the weed program. The first thing done was to hold meetings in community meeting places, one for every two townships. Letters were sent out from the County Extension Office to all farmers in the county. Newspaper and radio releases were used for each meeting. It was realized that interest should not only be instilled in the farmers, but city folks, landlords, legislators, county and township officials too. Weed displays were sponsored by the stores in Sioux Falls and a weed display booth has regularly been put up at the County Fair. Meetings were held during the winter and spring months on weed chemicals, equipment calibration, and weed surveys. The county purchased chemicals and sold them to farmers at cost.

Each of the township weed representatives had two townships in which to make a weed survey of eight noxious weeds on a weed map. Some of the weed representatives appointed as high as six men to help on the survey. Each representative used his own method of completing the survey. They were told what would happen to the valuation of the land, the loss in yields of crops, and what effect this would have on the economy within the community.

Farmers, township weed representatives, and county weed board members must be in charge of the meeting, for it is *their program*. Someone has said that "farming is a controversy with weeds." They are the people involved in the "swallowing up" by increased weed infestation. A piece of ground badly eroded can be made to produce at much less cost, then when infested with noxious weeds.

When you have well informed people on a project, they are easier to talk to and they can be involved, or stimulated into getting something done easier. Folks were shown that there was a need for such a program. The local weed situation and results were brought up to date by charts and by local colored slides at every meeting.

All of this took place in the county under the county agent's supervision back in 1946. There was a county weed board elected by the twelve township weed representatives. The weed board had no funds and power of enforcement. We didn't have a county weed supervisor in the county until 1948.

The county agent and county weed board met with the county commissioners in 1947 to set up a weed budget of $10,900. A special radio program on KSOO every Friday noon by the weed supervisor was started. Warnings were given out on chemicals being sold, prices being charged, and spraying charges. The county weed board had in mind to buy a sprayer and chemicals, when they first set up the budget. The board never did get into the chemical or weed spraying program. We think we were very fortunate here, because of some of the experiences some of the counties had. 2,4-D was new and a lot of interest was stimulated in weed control by this chemical.

Right here the people should have been told that 2,4-D had to be used every year like any other "tool" is used in controlling weeds. There were good results and some poor results, but the poor results kept increasing on the perennial weeds. People had gotten the idea that 2,4-D would be a "cure all" of all weed problems, or "knock'em dead" one treatment, which we know today is wrong.

In 1948 the county weed board appointed a county weed supervisor to make contacts for the weed board in chemicals, spraying problems, weed survey, and to get cooperation from the farmers, highways, railroads, parks, cities, and landlords. The county commissioners went out of the chemical business that year. This year a weed representative was elected from each of the 24 townships. These weed representatives are voluntary neighborhood leaders elected by farmers within the township. The weed survey had become too heavy a load for one representative for two townships.

The county weed supervisor summarized the township weed patches each year and he gave a summary every year at the annual education meetings. The cooperation obtained and the cost of the program was included too. Field days were held in the county on the calibration of farmer-owned weed sprayers. Here we were encouraging people to own their own sprayers so as to get the spraying done at the proper time and to get the chemical on in the right amount and often enough. As a result many farmers did custom work. 4-H youth were encouraged to make weed mounts identifying the flower, root, leaf, and seed of the weeds.

In 1949-1950, pre-emergence spraying came into the picture in regard to 2,4-D. This stimulated new interest.

In 1950 educational meetings on corn borer and weed control were held together. A special circular letter went to all farmers, feed, seed, chemical, and machinery companies and banks. 3,000 were sent out. Every person at all our meetings received new bulletins on weed control and corn borer control. The weed supervisor's office is located in the same office area as the County Extension Service. He makes use of Extension stenographers and pays for stenographer's help. He is in on office planning meetings. Weed mounts of secondary and primary noxious weeds were purchased for the office to use at meetings, in window displays and in educational booths. The weed budget was reduced to $4,800 because there was no use for the purchasing of chemicals and spraying equipment now.

In 1951 people were asking for weed control enforcement. This was handled by the county weed supervisor and state weed supervisor who explained to the landowner that he must control the seeds of the noxious weeds, or steps would be taken by the state and the expense charged to their taxes. Many times after the county weed supervisor talked to them, and he got someone to do the spraying for them, they took care of their weeds. However, there were a few that pressure had to be put on by the County Weed Board and the State Weed Supervisor. A file of all custom weed sprayer operators is kept in the Supervisor's office.

On May 1, 1953, the weed program received quite a setback when the county weed supervisor resigned. The chairman of the weed board resigned because of his health. The regular KSOO weed program was discontinued. May 15, a new weed supervisor was appointed. He needed training in education methods, research, weed identification, and chemicals by the county agent.

In 1954 the county agent arranged a noon luncheon sponsored by local chemical companies for all township officials, to try to get better cooperation and interest in the townships. Township officials agreed to appoint

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township weed representatives to serve three years. This same year a county commissioner was placed on the weed board and he has been on there ever since. After this the county commissioners were more interested in keeping the weed program and the weed supervisor.

In 1955 the educational meetings were carried on with the ASC. A luncheon was arranged by the county agent at the Chamber of Commerce for township clerks and township weed representatives. Dr. Lyle Derscheid and Keith Wallace were the speakers on, "Perennial Weeds; Their Control, and Chemicals."

Regular monthly meetings are held by the county weed board every year. The Extension Service is held responsible for carrying on the education part of the program. We now have the township officers involved in the program after several years of education. They appointed the township weed representative who serves for three years. Here the county weed supervisor (who is the "king pin" of this organization) has a very important duty in making contacts. Making personal contacts ranks at the top in making a stronger organization.

More responsibility and prestige must be built in the importance of being a township weed representative. We all agree that coordination and cooperation are essential to have an active program. There must be loyal fellowship developed where local leadership is fostered and maintained on a democratic basis.

A person in charge of involving people in a weed program has a very important task of locating "key" people in the different communities to be leaders. From different communities must come our township weed representatives and county weed board members. They must take on their responsibilities voluntarily.

The principal thing to keep in mind in involving people is that education, research, organization, and regulation are given equal emphasis. Interest, responsibility, and cooperation must be developed or accomplished in all four of these.

[1] Minnehaha County Agent, Sioux Falls, South Dakota.

WEED ENFORCEMENT—HOW CAN IT SUPPORT THE MUNICIPAL WEED PROGRAM

W. Lobay [1]

Every person in this country who assumes ownership or control of any land, assumes with it the responsibility of weed control. The conscientious farmer strives to keep weeds down, but in every municipality or county there are a few individuals who, in their farming practice, give little regard, if any, to weeds. The result is that weeds get out of hand, not only reducing the profits of the land where they are grown, but threatening the whole area. When they get to this stage, then the municipality through its Weed Inspector must take the responsibility to protect the surrounding farming citizens and the area as a whole from those who, through neglect, threaten the welfare of their neighbors.

In dealing with the farmers who have weed problems, there are three steps or phases that are usually followed—education, persuasion and enforcement. These are not separate entities but usually follow a sequence. First through various educational means, the farming public is given information and demonstration on how to cope with the problem. If individuals have not attended to it, the Weed Inspector usually uses his persuasive powers to convince the "customer" to carry out his obligations. This is the second step. Basically man is so constituted that he does not like being ordered or pushed around. Therefore, the principle of persuasion is a wiser course to pursue than to resort to the law of compulsion. Often, however, individuals are spurred into action by education and persuasion because they are aware that compulsion can follow and would detest disciplinary measures. It is obvious in these cases that just having the power to use the law will support the weed program and the third step may not be necessary.

Despite the adoption of these finer principles of education and persuasion, there are always a certain number of people who will not yield to them. It is here where the third phase of approach must be used, that of compulsion or enforcement. Where this is used intelligently and with discretion, the Inspector soon gains the confidence and respect of those from whom he received cooperation. Using that power as a last resort is a wonderful "ace in the hole" so to speak to the Weed Inspector or other regulatory officer who administers the Weeds Act.

Often in many municipalities and counties a weed problem exists on non-resident farms. Since such farms are "thorns" in a municipal weed program and since it is usually difficult to have such owners take any action —laying down the law is the only way that weeds will be looked after. Weed enforcement on such farms will be a factor in stimulating the neighboring resident farmers to do their best in weed control on their farms.

In the province of Alberta, comprising 50 municipalities and about 30 partially settled local Improvement Districts, there were some 70 Weed Inspectors and many other assistants operating, 42 of which are on a permanent basis. A number of these men were contacted regarding weed enforcement and their comments are worthy of noting. A few remarks, in part, were as follows:

"If we didn't have the power to take court action against careless farmers, we would be in a very weak position. Although I had very few prosecutions in my 13 years of service, just having the Act to lean on has made the indifferent farmer take action in many cases."

"Any attempt to conduct a good weed control program without the Noxious Weeds Act to ensure compliance by those individuals who cannot be persuaded by other means would, in my opinion, render the whole program ineffective."

"I think perhaps that I have used about every trick in the book in dealing with "delinquents" during the last 8 years, in trying to spur them into action. In many cases it is time wasted to go back to the same individual repeatedly to try to persuade them to take suitable action. Two of these hard-to-handle cases came under close scrutiny this past summer. In both cases notices were issued to destroy weeds with ample time allowed to complete the job. When the time limit expired we moved in with hired equipment and did the job. At first there were violent reactions from the land owners. However news of this type of action quickly spreads around a community with the net result that other borderline individuals, who were leaning on their oars to see if we meant business, quickly got to work and caused us no more anxiety. This type of action in not hesitating to use enforcement where necessary has certainly done a lot to support the Municipal Weed Program."

It is interesting to note that of some 2,000 official notices issued to farmers to destroy weeds in Alberta last year, 1,990 complied with the notice, and court action had to be taken in only 10 cases. The weed notices were issued as a last resort, but from the example, this step appeared necessary in order that the 1,990 be spurred to take action.

Weed laws and their enforcement are as necessary and important in the successful administration of weed control as are traffic laws or any other law for the protection and welfare of our citizens. They act as guide posts to keep us in the right direction. The gun on the belt of a police officer may be compared to the Weed Act in the hands of a Weed Inspector. Seldom is the

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gun used but it aids in the public taking notice and obeying the law. So it is with the Weed Act. It gives that final punch that brings into action those individuals that are careless and indifferent to their responsibility in the control of noxious weeds.

[1] Alberta Department of Agriculture, Edmonton, Alberta.

EDUCATION AS A FOUNDATION TO COUNTY WEED CONTROL

Ben L. Chase [1]

Price county leads in weed control work

The reason that I chose this sub-title is because it refers to my own farm. I raise Herefords for breeding stock and I must move them from one pasture to another frequently. I do not own a horse and trying to drive them would create quite a problem, but by coaxing and calling I can lead them wherever I want them to go. There are always a few leaders in the herd that will come when I call them and then the whole herd will follow.

I have used this same method in weed control work. In the past the Weed Commissioner was looked upon as a warden or an officer trying to enforce the weed law. This method did not work; it only created enemies.

By teaching and actually helping

Farmers are telling us their weed problems and asking for help rather than trying to dodge the weed law. We have made friends wherever we went. Our first meeting was held early in the spring. All town and village weed commissioners were asked to attend. Special speakers gave talks on new weed control methods.

Chemical dealers were called on

We called on dealers to help them to order chemicals so that they would be available when the farmers needed them. This has been a problem in the past.

Working together

I always try to work with the local weed commissioner whenever possible to help teach them so they would be helpful in their own area. There were fifteen in the county who actually worked with me.

Custom sprayer available

We would make a check on sprayers available in each area to be sure that there were one or two in each area for hire to the farmers.

Town-owned sprayers

In some towns where there was no sprayer available, the town would buy one to be available for hire to farmers. This was the case in several towns and it worked out very well. When they were not in use on farms, the town would use them for roadside spraying. There are approximately forty sprayers in the county for hire at the present time.

Sprayer calibration

Whenever a new sprayer was purchased, we would try and set up a public demonstration on sprayer calibration. We would invite all the neighbors to attend. At these meetings many personal weed problems were discussed and remedied.

Problems

One of the biggest problems of spraying was that the farmers didn't use enough care in calibrating—either it was mixed too strong and killed new seedings or too weak and didn't do the job properly. Calibration is very important.

Would not hire out

Many sprayer owners, previous to these meetings, would not hire out because they were afraid they would not do a good job.

Sprayers not used

One incident occurred where a farmer asked if I would come out and help him get started in spraying. He had owned a sprayer for five years and didn't use it after the first year of poor results. Proper sprayer calibration and the right amount of acid content weed chemical made a success of weed control on this farm. Too often the acid content has been over-looked.

Dealers! Know what you are selling!

Too many times the dealers are not familiar with the acid content of the material they are selling. They sometimes use a lower acid content material as a price selling point rather than being interested in the repeated sales of a job well done.

General information

General information on weed control was handled through many demonstrations and farm visits. Chemical weed control is not the answer to all weed problems. Some cases were handled by pulling; some were handled by clipping and especially white cockle, one of our worst problems, was handled very nicely by pasture rotation. Kill a weed in time and you save ninety and nine.

Short news articles

Short news articles were printed in the local papers, explaining the control of weeds at the proper time.

Demonstrations

108 demonstrations were held in the county, using large and small sprayers. Public weed displays were held at public auctions, public gatherings, and public meetings. All meetings were well attended and some worthwhile discussions were held.

Weed spraying doubled each year

In 1955	600 acres sprayed
In 1956	1,600 acres sprayed
In 1957	3,200 acres sprayed

Results not always good

Yes, there were a few cases where the results were not as good as were expected but I can say that ninety per cent of the farmers who sprayed were well satisfied, and I am sure that the work will double in 1958—not by force but by cooperation.

[1] Price County Weed Commissioner, Phillips, Wisconsin.

A CHEMICAL FOR THE CONTROL OF WILD OATS: 1,2,4,5-TETRACHLOROBENZENE

M. J. Josephs, D. R. Mussell, J. K. Leasure and R. L. Warden [1]

Wild oats *(Avena fatua L.)* are a serious problem in the United States and in Canada where spring wheat is grown as the main crop. Research workers of The Dow Chemical Company have discovered that 1,2,4,5-tetrachlorobenzene kills wild oat seed.

1,2,4,5-Tetrachlorobenzene is a stable, white, crystalline solid with a molecular weight of 215.90; it has needle-like crystals which melt at 138°C.; it boils at 246°C. at atmospheric pressure; and it is almost insoluble in water, and only slightly soluble in alcohol, benzene, carbon disulfide and many other organic solvents.

Greenhouse Tests.

1. **Particle size and soil mixing.** Tests using 1,2,4,5-tetrachlorobenzene in dry formulations showed that, where soil mixing is adequate, complete control of wild oat is possible. Best results were obtained when the chemical was dispersed on fertilizer or granular clay having particle sizes of 60 mesh or smaller.
2. **Vapor diffusion in soil columns.** Twenty-four-inch soil columns were prepared. After 2 weeks at 45°F. the chemical had moved 1½ inches above and below the plane of chemical application. Columns held for 2 weeks at 45°F. plus 1 week at 90°F. showed movement of the chemical 1½ inches above and 6 inches below the plane of application.
3. **Herbicidal action in the vapor phase.**

A. Seed in dry, treated soil. Wild oat seeds planted in clay pots containing dry soil with 1,2,4,5-tetrachlorobenzene at rates of 5, 10, and 20 lb/A did not germinate when removed from the treated soil 72 hours later.

B. Seedlings in treated soil. Seedlings at the surface of treated soil grew normally at first but soon took on a bluish cast, grew more slowly than normal plants and showed several knobby protrusions in the primary root zone, no root hairs, no lateral branching and essentially no penetration into the treated soil.

C. Seedlings above treated soil. There was almost no root penetration into treated soil by seedlings growing in untreated soil.

D. In vitro exposure of seeds to vapors. Dry seeds of 15 species were exposed to a saturated atmosphere of 1,2,4,5-tetrachlorobenzene at temperatures of 45°F. and 85°F. but only seeds of wild oat were killed. When moistened seeds were germinated in a saturated atmosphere of 1,2,4,5-tetrachlorobenzene at 85°F., most species were affected. In a third test, when the same species were exposed to a saturated atmosphere of 1,2,4,5-tetrachlorobenzene at 45° in a moistened atmosphere for two days, then removed from the chemical and the temperature raised to 85°F., most showed normal germination.

Residual effects. Laboratory tests have indicated that 1,2,4,5-tetrachlorobenzene is not decomposed appreciably by soil organisms. This plus its relative insolubility in water suggests that it disappears from soil primarily by volatilization.

Chemical residues. Analytical work on possible residues of this chemical in food crops grown in treated soil has not progressed sufficiently to permit recommendation of this material for use in soil used for growing such crops.

Toxicology. Recommendations for the safe handling of 1,2,4,5-tetrachlorobenzene include precautions to avoid eye contact and to avoid prolonged or repeated contact with the skin. Hands and face should be washed thoroughly after handling. Although this material is only moderately toxic when swallowed in single doses, it has a high toxicity in repeated oral administration.

Field applications. The best field control of wild oat has resulted when the chemical was simultaneously spread on and mixed with the soil. Both fall and spring applications have been successful, although some adverse effects to spring-seeded sensitive plants have been noted.

Conclusions. (1) 1,2,4,5,-Tetrachlorobenzene will control wild oats when mixed in soil at rates of 5 to 10 lb/A. (2) The chemical is active in the vapor phase and diffuses to a limited extent through soil. (3) The material kills dormant and non-dormant seeds by vapor contact. (4) This material is a powerful root inhibitor for certain plant species. (5) Intimate mixing of the chemical with the soil is necessary for effective control of wild oats. (6) The vapor pressure of 1,2,4,5-tetrachlorobenzene is such that, in warm soil, the compound is dissipated in a few weeks. (7) Field tests have shown that pea, soybean, corn, navy bean, sunflower and safflower are tolerant; that sugar beet and flax are less tolerant; and that the small cereal grains are generally sensitive to the chemical. (8) 1,2,4,5-Tetrachlorobenzene offers a means of economically eradicating field infestations of wild oats.

[1] The Dow Chemical Company, Midland, Michigan.

PHYTOTOXIC PROPERTIES OF WILD OAT EXTRACTS (Abstract)

E. A. Helgeson and John Green [1]

Early studies concerning the nature of dormancy in wild oats led to the suggestion that the mechanism involved permeability of the seed or fruit coat to oxygen. More recent studies have demonstrated that certain seeds and fruits contain chemical substances which inhibit or prevent normal germination of seeds. In 1953 Elliott and Leopold reported the presence of an inhibator of amylase in the cultivated oat variety Victory and showed that it could be leached out in running water with a subsequent increase in germination of the seeds thus treated.

In our search for factors affecting the dormancy of wild oat seeds we repeated some of the treatments used by these latter workers. Leaching in running water for periods up to 48 hours had little or no effect in enhancing the germination of these dormant seeds. Various solutions containing sulfur, organic or inorganic compounds and enzymes likewise had no appreciable effect with the exception of gibberellic acid. This chemical markedly increased germination in wild oats.

An attempt was made to gain some notion of the effects of leachates from various wild oat materials. Plant extracts were prepared by leaching various amounts of whole seeds, or finely ground leaf or stem materials in distilled water for a period of 24 hours. These extracts were used to moisten 15 cm. filter papers in Petri dishes, on which non-dormant wild oat seeds were put to germinate at 20°C. At the end of 5 days, roots and shoots were measured. Data presented in this paper are based on averages of at least 100 individual measurements. This work was started in the spring of 1955 and is still in progress.

It was found that whole seed extracts had little or no effect on germination but did reduce the growth of roots at all concentrations. Seedling shoots were less sensitive to the inhibitor and at the higher dilutions there was some stimulation. A number of dilutions above 1:30 (1 gram plant material plus 30 ml water) were run up to 1:60 with a continued stimulation of tops. Instances of stimulation of roots at concentrations of 1:20 to 1:30 were found with an invariable stimulation at 1:40 or above.

Extracts of lemma and palea reduced germination when presented at a 1:5 dilution and also reduced shoot and root growth at a greater dilution i. e. 1:20. No appreciable effect on germination was noted at the greater dilutions. Shoot growth was affected adversely but not the root. Here the shoot appears to be more sensitive than the root.

Extracts of the caryopsis alone reduced germination to some extent at a 1:10 dilution or lower. This extract was more toxic to top growth than to roots.

When glumes only were extracted there was little effect on germination. A marked retarding effect on top growth at 1:10 concentrations and a lesser effect on root elongation was obtained. At 1:30 both root and top growth were stimulated.

Leaf extracts reduced germination at a 1:10 dilution and were extremely toxic to tops and roots. At 1:30 tops were stimulated but roots were adversely affected.

Extracts of panicle stem materials entirely stopped germination and seedling growth at 1:10 dilutions. Greater dilutions up to 1:30 had little effect on germination but proved to be extremely toxic to seedlings.

Stem extracts (upper node to base of first panicle branch) reduced seed germination by about half and practically prevented growth of seedlings at a 1:10 dilution. At greater dilutions up to 1:30 germination was reduced slightly and seedling growth was definitely reduced.

Toxic extracts were heat stable, were lost on dialysis and could be adsorbed on activated charcoal. Alcohol

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extracts (95%) were comparable to aqueous extracts in toxicity, but ethyl ether extracts were inactive.

Studies to definitely characterize the toxic principle are under way.

[1] North Dakota Agricultural Experiment Station, Fargo, North Dakota.

THE EFFECT OF GIBBERELLIC ACID ON DORMANT SEED OF WILD OAT (Abstract)

John G. Green and E. A. Helgeson[1]

Gibberellic acid, a metabolic product of a rice infecting fungus, *Gibberella fujikuroi*, has stimulated elongated growth to varying degrees in a number of plants.

To determine the effect of the chemical upon dormant seed of wild oat *(Avena fatua)*, duplicate and, in some cases, triplicate one hundred seed samples of dormant seed were placed between two number two filter papers in 12½ cm Petri dishes. Nine ml of solutions of various concentrations of gibberellic acid were placed over the seeds, and the germinators were incubated for five days or more in a darkened constant temperature room maintained at approximately 20°C. At various time intervals germination counts were made to ascertain the effectiveness of the chemical in breaking dormancy of the seed.

Initial trials with the compound on six-month-old seed indicated that gibberellic acid failed to affect germination of the seed; however, when a wetting agent was incorporated in the solution, enhanced germination resulted. A second trial conducted with hand selected secondary seed evidencing more pronounced dormancy produced the following results:

Treatment	Pct. germination after 5 days	10 days
Control—distilled water	12.4	12.4
50 ppm GA in water	74.5	85.9

Another trial conducted with varying concentrations of gibberellic acid indicated a response which increased with increasing concentration of the chemical in the following manner:

Treatment	Pct. germ. after 5 days	10 days
Control—distilled water	17.0	17.0
25 ppm GA in water	22.2	23.2
50 ppm GA in water	75.0	81.0
100 ppm GA in water	43.0*	88.0

The low germination indicated by the asterisk appeared to be caused by failure of the root and shoot to become visible due to growth inhibition by the chemical.

Tests conducted with seed produced by plants grown in the greenhouse indicated the existence of a time factor in activity of the compound; consequently, a complete assay of the effect of gibberellic acid on dormant seed harvested July 27, 1957, is being conducted. That the chemical becomes more effective with increasing age of the seed is evidenced by the following table:

Percent germination of wild oat seed of different ages.

Treatment	Age seed, days 30	60	90
Control—distilled water	4	13	30
250 ppm GA in water	27	27	43
500 ppm GA in water	29	46	62
100 ppm GA in water	50	72	83

Additional data indicate that the effectiveness of the chemical increases when the seeds are allowed to incubate for fifteen days rather than for five days.

Currently, the status of field utilization of gibberellic acid in this phase of weed control is not apparent; however, the chemical constitutes an excellent tool for exploration of the phenomenon of post-harvest dormancy of wild oat seed.

[1] North Dakota Agricultural Experiment Station, Fargo, North Dakota.

ARTIFICIAL INDUCTION OF DORMANCY IN WILD OATS AND FACTORS INFLUENCING THIS RESPONSE (Abstract)[1]

J. R. Hay and B. C. Cumming[2]

It was shown that secondary dormancy could be artificially induced in wild oats *(Avena fatua* L.). A suggested procedure would be to immerse seed in boiled water at 25°C. The seed should be transferred to moist filter paper in light after 48 hours soaking. Only a few seeds will germinate after the soaking period and if these are discarded at 4 days the remaining seeds will be over 90 per cent dormant even if the hulls are removed. The seed is still viable since it will germinate if the seed coat is punctured.

This dormant seed has a low oxygen uptake, although fully imbibed at 25°C. Puncturing the seed coats and treating the seed with KNO_3, $NaNO_3$ or gibberellic acid increased the per cent germination of seed with artificially induced dormancy just as with naturally dormant seed. The former also remained dormant when transferred to soil.

The method provides a simple means of obtaining a constant supply of seed with a high degree of dormancy. This eliminates the necessity of working with freshly harvested seed which may be rapidly losing its dormancy or which may have a low degree of dormancy at harvest time.

[1] A paper with the details of this work has been submitted elsewhere for publication.
[2] Dept. of Agriculture, Ottawa, Canada.

RETARDING ABSCISSION OF WILD OAT SEEDS WITH CHEMICALS (Abstract)

E. A. Helgeson and John Green[1]

Many wild oat seeds ripen early and fall to the ground well in advance of normal ripening of the crop in which they are growing. This makes it difficult to control this weed since the seeds are not picked up by the harvesting equipment.

It occured to us that chemicals such as napthalene acetic acid (NAA) might prevent early abcission of seed or that they might induce an early seed drop before the seeds were ripe and capable of growth.

We grew wild oat plants in pots in the greenhouse last spring and treated them with NAA, 2,4-D, and the potassium salt of gibberellic acid (KGA). Chemicals were applied to the soil, sprayed on the plants or applied to the base of spikelets in lanolin paste.

Paste treatments of NAA and KGA applied to spikelets just after fertilization had occurred were the most effective. The concentrations used were 0 (lanolin), ⅛, ¼, ½, and 1.0%. Results are reported as percent of

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control. Data were recorded at three stages; when the first seeds abscissed, at 50% abscission, and at complete or total abscission.

When the NAA pastes were applied to the base of intact spikelets there was a slight delay in total abscission at the 0.50 and 1% concentration (103 to 108 % of control). Secondary and primary seeds were similar in delay.

NAA applied to the base of florets from which glumes were removed gave a marked retardation at all stages with all concentrations for the secondary seeds (109 to 140 %). Primary seeds showed a greater retardation than secondary seeds. At the 0.25 to 1.00 % concentrations seeds never did absciss but remained firmly attached to the stem.

With paste applications of KGA to intact spikelets there was a somewhat greater delay in abscission than with the corresponding NAA treatment with secondary and primary seeds at all stages (105 to 123 % of control). All seeds did finally drop. No records are available for deglumed florets.

[1] North Dakota Agricultural Experiment Station

AN APPRAISAL OF LOSSES CAUSED BY WEED COMPETITION IN MANITOBA GRAIN FIELDS[1]

George Friesen[2]

This paper deals with a study initiated in 1956 and reported briefly at the 1956 Conference (NCWCC Proc. 13:52-53, 1956).

In early April, 1957, fifty farm fields were located at random in an area within a 60-mile radius of Winnipeg. The procedure for selecting farm fields, staking of plots, weeding and recording of data was reported in 1956. Of the fifty fields included in 1957, 22 were seeded to wheat, 12 to barley, 5 to oats, and 8 to flax. Three fields were abandoned because of flooding and hail damage.

Weed counts. Over 30 different weed species were found growing in the fields. Total weed counts ranged from 25 to 2221 plants per square yard in 1956; and 13 to 867 in 1957. The overall average weed count was 283 per square yard in 1956 and 235 in 1957. Wild mustard was still a very prominent weed, contrary to what would be expected because of the wide use of 2,4-D and MCPA. Green foxtail was found in high numbers on the lighter soils. Wild oats were found in all fields. Canada thistle, sowthistle, and wild buckwheat appeared to be on the increase, particularly on the heavier soils.

Weed competition. Yield reductions due to weed competition ranged from 0.1 to 47.2% in 1956 and from 0 to 61.5% in 1957. As would be expected, lowest reductions were recorded in fields having low weed counts. In general, low weed counts followed a year of highly competitive crops, such as (1) sweet clover (2) sugar beets or other row crops, (3) summerfallow or (4) resulted from early spraying in the current crop. The greatest losses and highest weed counts occurred in crops grown on stubble land or where spraying was not a regular farm practice.

The average reductions in yield due to weed competition in the various crops are presented in Table 1.

Table 1. Yield Reductions from Weed Competition.

	Percent crop yield reduced				Average
Year	Wheat	Barley	Oats	Flax	all crops
1956	19.5	11.9	10.6	26.6	15.9
1957	14.3	18.6	6.5	27.6	17.3

The presence of many different weed species in most fields made it difficult to measure the competitive effects of a single species. However, in several fields where a single weed species predominated a rough estimate has been made. Wild oats, wild mustard, and possibly wild buckwheat showed serious competitive effects. Green foxtail was not a serious competitor in wheat, oats and barley.

Spraying vs non-spraying. To observe the effectiveness of 2,4-D and MCPA in reducing weed competition the cooperating farmer was asked to spray 5 paired lots and miss the other five, providing he intended to treat the balance of the field. In two years 18 co-operators actually sprayed as instructed. Overall average yield losses in sprayed and not-sprayed plots are presented in Table 2.

Table 2. Effect of 2,4-D and MCPA on Weed Competition.

	Percent crop loss from weed competition			
	Wheat 10 fields	Barley 2 fields	Oats 4 fields	Flax 2 fields
Sprayed	5.0	10.1	8.2	18.2
Not-sprayed	14.5	15.1	14.6	17.8

From the above data it will be noted that spraying reduced weed losses to a considerable extent, particularly in wheat and oats. However, yield reductions were not completely eliminated, probably for these reasons: (1) spraying too late and (2) presence of resistant weeds. In both flax fields the predominating weed was wild oats and consequently no yield benefit could be demonstrated from spraying.

Weed competition and crop quality. In 1957, the percent protein was determined on paired weeded and non-weeded plots of wheat and barley. To date, proteins have been run on the grain samples collected from 10 fields and data are presented in Table 3.

Table 3. Effect of Weed Competition on Protein.

	Increase for weed removal			
	Wheat		Barley	
Location	Yield Bu/A	Protein Pct.	Yield Bu/A	Protein Pct
1	2.9*	.412*	9.7*	.549**
2	4.5*	.103	9.1**	—.043
3	8.5**	.062	3.1	.114*
4	8.2**	.969**	8.5*	.428**
5	10.7**	.002	2.2*	.423*

* Significant at 5% level of probability.
**Significant at 1% level of probability.

The limited data available indicate that controlling weeds not only helps to increase yield, but often should increase protein content as well.

Provincial losses. If we can project the losses caused by weed competition on these fields to the whole of Manitoba, then the overall annual losses for the province can be calculated. Using the loss figures in Table 1, the following losses for the province have been calculated:

Table 4. Losses Due to Weed Competition in Manitoba.

	1956		1957	
Crop	Loss in bushels	Loss in dollars*	Loss in bushels	Loss in dollars*
Wheat	13,565,000	$20,348,000	7,510,000	$11,265,000
Oats	10,908,000	6,545,000	4,032,000	2,419,000
Barley	5,673,000	5,106,000	7,540,000	6,786,000
Flax	2,900,000	8,700,000	1,335,000	4,005,000
Total	33,046,000	$40,699,000	20,417,000	$24,475,000

* Based on the following values per bushel: wheat—$1.50, oats—$.60, barley—$.90, flax—$3.00.

If we add to these losses in production a decrease in crop quality, the annual weed bill becomes even more significant.

[1] This study was made possible through an Extra-mural research grant from the Science Service, Dept. of Agriculture, Ottawa.
[2] The University of Manitoba, Winnipeg, Canada.

CORN-WEED COMPETITION WITH VARYING SOIL FERTILITY AND MOISTURE (Abstract)

By Jorge Nieto and David W. Staniforth [1]

The present work represents an extension of a previous investigation of the competitive effects of annual grass weeds on corn yields. Experimental areas infested with yellow foxtail *(Setaria lutescens)* and green foxtail *(Setaria viridis)*, were planted with a single cross corn hybrid in rows 40 inches apart and in hills 20 inches apart in the rows. Optimum amounts of P and K fertilizer were applied over the areas prior to corn planting. Weed infestations were maintained at various levels, including weed-free, over the entire growing seasons. Yields of mature weeds ranged from 1,000 to 4,000 pounds dry matter per acre under the various experimental conditions encountered. The experiments were conducted at two locations on the same experimental areas in the seasons of 1956 and 1957. At Kanawha, Iowa, corn plant populations were 8, 12, 16 and 20 thousand plants per acre, nitrogen fertilizer treatments were 0, 70 and 140 pounds of nitrogen per acre, and no supplemental irrigation water was used. At Ames, Iowa, corn populations were 12, 16, 20 and 24 thousand plants per acre, nitrogen fertilizer applications were 0 and 70 pounds of nitrogen per acre, and supplemental irrigation water was available. Yields of weeds and corn at maturity were obtained.

Experimental Results at Kanawha

With nitrogen fertilizer applications of 0, 70 and 140 pounds per acre, annual grass weed infestations averaged 1,500, 2,000 and 2,200 pounds per acre and resulted in corn yield reductions of 20, 14 and 11 bushels per acre respectively. Growth and yield of weeds were suppressed as corn plant populations were increased from 8 to 20 thousand plants per acre. However, corn yield reductions due to weeds were essentially similar at 8, 12 and 16 thousand plant stands, and were slightly lower with 20 thousand, within each experimental fertility level. Corn yield reductions in bushels per hundredweight of weed infestation were greatest with low nitrogen fertilizer and lowest with 140 pounds per acre of nitrogen fertilizer. The fraction, bushels reduction per cwt. weed infestation, increased as corn populations increased within each fertility level. The general effect of nitrogen fertilizer was to minimize the losses in corn yield due to weeds. Thus the corn yield reduction from 2,000 pounds of weeds at 0 level of N was considerably greater than the reduction at the 140 pound per acre level. This effect was most evident with 8 and 12 thousand corn plants per acre. With corn plant populations of 20 thousand per acre, a given weed infestation resulted in about the same degree of corn yield reduction at all three levels of nitrogen fertilization. The effect was possibly due to the effects of competition between corn plants as well as competition of weeds, at these high corn plant population levels.

Experimental Results at Ames

The reductions in corn yield from the competitive effects of foxtail infestations followed the same general pattern observed in the experiments at Kanawha. The addition of nitrogen fertilizer minimized the effects of weeds on corn growth, weed growth and yields were suppressed with higher corn plant populations, and the reduction in corn yield per hundredweight of mature foxtail infestation increased with the higher rates of corn planting. The combined effects of nitrogen fertilizer applications and supplemental irrigation water greatly minimized the effects of foxtail competition on corn, but did not always result in no corn yield reduction due to the weeds. Where no nitrogen fertilizer was added, irrigation water alone did not fully eliminate the competitive effects of foxtail on corn.

[1] Iowa Agricultural Experiment Station, Ames, Iowa.

COMPETITION EFFECTS OF MUSTARD AND FOXTAIL MILLET ON PROCESSING PEAS[1]

D. C. Nelson and R. E. Nylund [2]

Processors agree that weeds are a serious problem in many pea fields. However, since the costs of weed control must be justified by increased yields and/or lower processing costs, the present study, carried on in 1956 and 1957, was undertaken to evaluate the effects of different weed populations and weed species on the growth of vines, yield of shelled peas, and weight of weeds in peas.

In 1956, processing peas, variety Perfection Freezer, were grown in competition with 0, 1, 3, 9, and 27 plants per square foot of mustard *(Brassica hirta)* alone, foxtail millet *(Setaria italica)* alone, and mixtures containing equal numbers of mustard and foxtail millet. During the 1956 season mustard and foxtail populations were carefully controlled by hand thinning as soon as they emerged. All other weeds were removed at emergence. Weeds were removed from one set of plots when the peas reached the 9-10 node stage, when the mustard was about 10" tall and the foxtail 6" tall. In the other set of plots weeds were allowed to remain to crop harvest.

In 1957, two different weed populations were established by seeding the weeds at two different rates. Populations of mustard averaged 5 and 12 plants per square foot and foxtail 27 and 69 plants per square foot on June 12. All the mustard had emerged before this date, while the foxtail attained twice this population 6 days later. No other attempt was made to control the populations of mustard and grass. Weeds were removed from one set of plots when the peas had reached the 5 node stage, when 25 percent of the grasses had emerged and the mustard was 1-4" tall. Weeds in another set of plots were allowed to remain to crop harvest.

Mustard was a much more effective competitor with peas than foxtail. This was partly due to the rapid emergence of mustard (2-5 days before the peas) and the slow emergence of foxtail (10-30 days after peas). Likewise mustard grew rapidly under the low temperatures of May, while foxtail grew slowly. When mustard plants were evenly distributed, as in 1956, low populations reduced the yield of shelled peas even though the mustard was removed when the peas were at the 9-10 node stage (Table 1). When competition was continued to crop harvest, reduction in the yield of shelled peas was greater. The effect of mustard on pea vine growth showed a similar trend.

Of the populations used in this experiment, foxtail was not a serious competitor with peas when removed by the time peas reached the 9-10 node stage. Moderate populations of foxtail in 1956 decreased the yield of shelled peas and growth of vines when competition continued to crop harvest.

The two populations of mustard in 1957 (5 and 12 plants per square foot) reduced pea vine weights to approximately the same degree as the 3 and 9 plant populations of 1956. This was due to the fact that in 1957 the average weight per mustard plant was lower because the late emerging mustard plants were not removed in 1957 as in 1956. The greatest difference between the two years was in the effect of mustard on yield of shelled peas when competition continued to pea harvest. Yield reductions in 1956 from 3 to 9 mustard plants per square foot were 58 percent and 88 percent, respectively. In 1957, the lower mustard populations reduced yield 40 percent and the higher populations reduced yield 67 percent.

Foxtail germinated slowly in 1957 (50 percent emergence about one month after pea emergence), and subsequent growth was poor. Reductions in weight of pea vines and yield of shelled peas in plots containing foxtail are principally attributed to a soft rot type of decay. Conditions were favorable for decay in these plots

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because the grass prevented drying of the pea vines between frequent rains late in the season.

Table 1. Yields of shelled peas per acre under various populations of mustard and foxtail, 1956.

Weed plants per sq ft	Yield of peas from plots containing: Mustard	Foxtail	Mustard and foxtail
	Weeds removed at the 9-10 node stage		
	(100 lb)	(100 lb)	(100 lb)
0	39	38	37
1	36	39	37
3	29	44	29
9	19	41	27
27	3	37	12
	Weeds left in until harvest		
0	33	36	34
1	33	34	30
3	14	33	17
9	4	25	6
27	0	15	2

$LSD_{05} = 10$ $LSD_{01} = 13$

Rainfall in 1956 and 1957 was adequate for both weeds and peas, though there was a small reduction in available soil moisture by the highest population of mustard and of grass in 1956. In 1957, the weeds had no measurable effect on soil moisture.

[1] Paper No. 3867, Scientific Journal Series, Minnesota Agricultural Experiment Station.
[2] Department of Horticulture, University of Minnesota, St. Paul, Minnesota.

SOIL INCORPORATION OF CDAA (Abstract)

R. L. Gantz and F. W. Slife[1]

The need for rainfall soon after the application of a pre-emergence herbicide in order to obtain good weed control has often been noted. On this basis it seems possible that deliberate, mechanical incorporation might be a means of consistently obtaining satisfactory results.

To test the possibilities of soil incorporation, a factorial field experiment was conducted on a silt loam soil in 1956 and repeated on the same location in 1957. After a heavy broadcast seeding of millet *(Setaria italica)*, corn was planted and 0, 2 and 4-pound rates of alpha-chloro-N,N-diallylacetamide (CDAA) were subjected to the following incorporation treatments:

1. Undisturbed (corn planted before treatment)
2. Incorporated 1-2 inches deep with a spike-tooth harrow (corn planted after treatment)
3. Incorporated 3-4 inches deep with a tandem disk (corn planted after treatment)

Half of each treatment was kept weed free and the other half was never cultivated. All treatments were replicated 4 times. Visual ratings were made after 3 and 7 weeks following treatment. After harvesting the corn, the yields were determined and statistically analyzed.

Grass control by 4 pounds of CDAA was good on most plots through 7 weeks and somewhat better than the 2-pound rates both years. Incorporated CDAA gave a little less grass control than the undisturbed applications for 7 weeks in 1956, but in 1957 no detrimental effect from incorporation was detected until the second ratings were taken (7 weeks). CDAA did better when harrowed than when disked, but the differences decreased with time.

Corn yields were not significantly affected either year by the incorporation of CDAA. Harrowed and disked applications yielded approximately the same in 1956, but disking was a little better in 1957. Yield responded greatly to chemical treatment both years. The yields from 4 pounds of CDAA were better than those from 2-pound applications in 1957, but not in 1956. Cultivation caused considerable improvement in the yield from chemical treatments, but the uncultivated 4-pound treatments yielded the same as the cultivated checks both years.

Rain occurred within a few days after treatment both years, so the effects of incorporation followed by a week or more of dry weather were not tested either year in this experiment. On a smaller, related field experiment, 4 pounds of undisturbed CDAA allowed millet to become established to a certain extent in the absence of a post-treatment rain. In the same experiment, incorporation of CDAA resulted in complete millet control.

Preliminary laboratory work has indicated that the importance of soil incorporation for CDAA may be closely dependent upon the adsorption and volatility of this herbicide. Further investigation of these factors is planned.

Under the conditions of this experiment:

1. Soil-incorporated pre-emergence applications of CDAA gave slightly less grass control than undisturbed applications but had no significant effects on corn yields.
2. 4 pounds of CDAA controlled grass better than 2 pounds both years but yielded better the second year only.
3. Cultivation increased corn yields from the chemical treatments while the uncultivated 4-pound treatments yielded the same as the cultivated untreated plots both years.
4. Incorporated CDAA worked practically as well as the undisturbed or ordinary pre-emergence applications when rainfall occurred within a few days after treatment. Indications are, that incorporated treatments will be somewhat *more effective* than ordinary pre-emergence applications when no rain occurs relatively soon after treatment. Therefore, mechanical soil incorporation should lessen the chances of failure from this pre-emergence herbicide, and offers possibilities for other pre-emergence herbicides.

[1] University of Illinois, Urbana, Illinois.

FACTORS AFFECTING GERMINATION OF CANADA THISTLE AND PERENNIAL SOWTHISTLE SEEDS

Sam Zilke and Lyle A. Derscheid[1]

The control of Canada thistle and perennial sowthistle will eventually require the elucidation of various aspects of the life history of these two species. An important part of the developmental life history of a species is the gemination of the seed. In this project the physical factors of the environment affecting germination were studied.

The physical factors selected for study were temperature and moisture of the soil, light, and depth of the soil. The experiments were conducted in the field, laboratory, and greenhouse concurrently. The tests in laboratory and greenhouse were designed for the purpose of studying the factors occurring in the field in isolation.

In 1956 a series of tests were made on freshly harvested thistle seed to determine what sequence of the environmental complex of light and temperature would bring about a high degree and the same degree of readiness to germinate. The sequence of cold for 7 days, light for 4 days, followed by darkness, was found to be one of the more favorable pre-treatments of seed for both

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species. This pre-treatment was used for all seed tested in subsequent experiments.

Four lots of 100 seeds were used as the unit in all tests. Canada thistle seed was planted at a depth of 0.4 inches and sowthistle at 0.2 inches.

The effect of temperature on germination was studied in control chambers at 20°, 34°, 64°, 72°, and 88°F. The test material was planted in greenhouse plots. The temperature was measured at the ½ inch level in the soil and moisture content was kept at field capacity. There was no emergence at 20 and 34°F. The emergence of Canada thistle within the first 10 days was 22.0% at 64°F, 32.5% at 72, and 52.7% at 88. Emergence varied directly with the temperature. Sowthistle emergence showed a similar trend, being 1.5, 10.5, and 15.0%, respectively. The emergence of sowthistle was 1.5% in 10 days but increased to 4.3% in 21 days at 64°F while at 88°F emergence increased only from 15.0 to 16.0%. Thus the rate of emergence is also slower at the lower temperature in addition to having less total emergence.

The moisture content of the soil is complementary in effect to temperature. The effect was studied by planting 100 seeds on the surface of 150 grams of soil in a plastic germination dish 4¾ inches square and covering them with 50 grams of soil. Three levels of soil moisture were tested, ¼-, ½-, and field capacity, in a control chamber at 65°F. Emergence of Canada thistle was 1.5% at F.C., 14.2 at ½ F.C., and 18.2 at ¼ F.C. in 10 days. Sowthistle had an emergence of 0.8% at F.C., 0.5% at ½ F.C., and 0.0% at ¼ F.C. Tests at 75°F. for both species showed similar trends. Canada thistle had greater germination at the lower moisture content while that for sowthistle was reversed, high germination with high moisture content.

The results of the simultaneous integrated effects of temperature and moisture could be studied in the field. The two species were planted at 3 locations in eastern South Dakota, being in a line from east to west, varying in climate, particularly in humidity. The planting and the count of emergence was at two week intervals.

Gary, the most eastern site, had a temperature of 80°F at the ½ inch level on June 27, date of the first planting, and a moisture content of 19.5% in the first inch of soil. On July 10 when the temperature had reached 102°F., and moisture content was 16.9%, emergence was 4.3%. During the continued high temperatures of 98, 99, and 85 in July and August and moisture contents of 12.9, 19.5, and 22.0%, respectively, at the 2 week intervals, there was no emergence. On September 6, temperature had decreased to 80°F. while moisture content remained approximately at field capacity, being 23.1%, emergence was 47.0%. At Castlewood, where temperatures were somewhat higher and moisture content considerably lower, emergence in early July was 1.5% but in cooler weather in September, emergence was 31.7% at a moisture content of 13.6%. At Brentford temperatures and soil moisture content were similar to those at Castlewood but emergence was 4.3% in early July but only 8.8% in early September. There was less than 1% emergence of sowthistle at all 3 sites in July and August. In September emergence at the respective sites was 8.3, 5.5, and 5.5%. The somewhat higher emergence occurred at the moister site. Apparently, there is little germination of either Canada thistle or sowthistle in July and August in South Dakota.

The depth from which seedlings would emerge was studied in the greenhouse. The depths tested were 0.2, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, and 4.0 inches for Canada thistle and 0.1, 0.2, 0.8, 1.2, 2.0, 2.4, and 4.0 for sowthistle. Maximum depth of emergence for Canada thistle was 1.2 inches while for sowthistle it was less than 0.8 inch. The rate of emergence of Canada thistle was retarded by depth; for example at 0.4 inch, emergence was 7.0% in 10 days but within 31 days it reached 19.0. The shallowest depth tested had the most rapid and highest percentage of emergence for both species.

The depth experiments were further treated, at the end of 30 days or more. In one set soil was removed to the 0.4 in. level for Canada thistle and 0.2 in. level for sowthistle. In another set soil was removed to the level of the seed, treated with cold and light, then covered again with soil. In the set where soil had been removed to 0.4 in. there was little germination of Canada thistle seed that had been planted at 2.0 in. or less but that planted at the 4.0 in. depth had 2.0% germination in 68 days. The set that was further treated with cold and light also had very little germination. There was a similar trend for sowthistle. These results suggest the possibility either that very little of the cold and light treated seed survives for more than 30 days when buried at depths less than 4.0 in. or that it enters a secondary dormancy which was not broken by the methods used.

[1] Graduate Assistant and Associate Agronomist of South Dakota State College, respectively. Research done in collaboration with N. C. Regional Project 10 Subproject 3.

PROGRESS ON SIMAZIN AND THE RELATED COMPOUNDS

Edwin O. Schneider[1]

During 1956, the Geigy Chemical Corporation of New York released to Experiment Station personnel for test purposes a herbicide called 2-chloro-4,6-bis-(ethylamino)-*s*-triazine (Simazin). Last year at the NCWCC the Company announced that Simazin was again available for testing as were small amounts of five related compounds. The following gives the chemical name, reference number or name and similarities of the triazines:

Simazin is 2-chloro-4,6-bis-(ethylamino)-*s*-triazine
G-27901 is 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine
G-30031 is 2-chloro-4diethylamino-6-isopropylamino-*s*-triazine
G-30028 is 2-chloro-4,6-bis-(isopropylamino)-*s*-triazine
G-30044 is 2-methoxy-4,6-bis-(ethylamino)-*s*-triazine
G-30451 is 2-chloro-4-n-propylamino-6-isopropylamino-*s*-triazine

The purpose of this paper is to (a) discuss briefly the herbicidal activity of the compounds, (b) indicate the tolerance of agricultural crops, and (c) discuss briefly some biological testing now in progress.

Simazin was released to experiment station workers in 1956 and was found to be very promising as a pre-emergence weed control in corn where tested. Therefore in 1957 the majority of research work was directed to Simazin because of the favorable 1956 results, widespread interest in testing the chemical and an abundant supply. G-27901, G-30031 and G-30028 were tested in small plots in many locations along with Simazin.

Chemical and physical properties. Simazin is a white crystaline substance having a melting point of 225°C with a solubility in water of 3.5 ppm, in methyl alcohol 400.0, in petroleum ether 2.0 and in chloroform 900.0. It is comparatively non-toxic; the acute oral L.D. 50 to mice is greater than 5 gr./kg. No irritation to skin, eyes or mucous membranes have been reported in 2 years of field and laboratory testing. The related compounds are quite similar to Simazin in physical appearance except G-30031 which is a solution.

Herbicidal activity on weeds. In tests observed this past season Simazin has displayed the most herbicidal activity to annual broadleaf weeds and grasses and on some perennials. In general 2 lb/A of Simazin pre-emergence has been capable of eliminating weeds in corn whereas 3 to 5 lb/A of G-30028, G-30031 and G-27901 were required for the same control. Of these related compounds, G-30028 appears to have the most toxicity to weeds. G-30451 and G-30044 were evaluated in several places and felt to be under Simazin in performance to weeds.

Under ideal conditions these compounds will give about equal kill of weeds when the rates are adjusted.

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Under adverse conditions when the soil surface is dry at application and remains dry for some time, germinating weeds in the moist area below the treated dry zone will grow through the treated zone unharmed. Under these conditions Simazin has given good control when seeding and first rain were separated by 12 to 14 days. The related compounds under these conditions did not give as good control as did Simazin.

Adequate rates are necessary for weed control. However, when slightly lower rates are used growth is usually noted first in the grassy species, the *Panicum* species being the first to appear. Under these conditions growth of grasses appears in corn from 4 to 8 weeks after application while the broadleaf species are usually adequately controlled. With continuously decreased rates more species of grasses appear along with velvet leaf and ragweed.

Herbicidal effect on crops. The outstanding feature of the triazine derivatives is their selectivity to corn at rates far above those necessary for weed control. Only G-30044 as a pre-emergence application has resulted in injury to corn.

Besides corn, Simazin has demonstrated a high degree of selectivity on asparagus, sugar cane, pineapples, brambles, grapes, fruit tree plantings, and nursery plantings. Moderate resistance has been noted in sorghum, mint, potatoes, and cranberries, and varying degrees of tolerance have been demonstrated on onions, carrots, lima beans, and strawberries.

G-27901 appears very promising on peas as a pre- and post-emergence application for weed control and as a pre- and post-transplanting application on tobacco. Besides these uses, G-27901 should be evaluated again for lima beans, onions, cranberries, and soybeans.

G-30028 has given weed control without injury to carrots in several tests. However, the performance on other crops is not superior to Simazin or G-27901. G-30031 was not superior on any series of crops. There are not enough data to accurately evaluate G-30044 and G-30451.

Biological testing. Several experiment station workers are seeking biological methods to determine rapidly and accurately the residual or carry-over effects of Simazin and other triazines in the soil. These workers are evaluating test plants as well as procedures. Several others are studying labeled Simazin to determine the extent of uptake by plants and decomposition within the plant.

Plants already evaluated for testing are barley, wheat, oats, sunflower, sorghum, ryegrass, tomatoes, radish, beets, squash, pumpkins, etc. Missouri utilized ryegrass as the test plant to determine if Simazin remains in the soil. In the Horticulture Department at Purdue, tomato plants have been used for determining residues. Tomatoes appeared to be the most sensitive plant in their screening program.

In Illinois oats have been selected as the test plant. Personal communications from Dr. Fred Slife indicated preliminary runs of his biological test will detect .06 ppm of Simazin in a silt loam in pots in the greenhouse. Evaluation was made on the dry matter produced in the pots in four weeks.

Rates of disappearance of Simazin and the related compounds are needed in all of the major soil types. Biological tests using field soils will serve as an indication of the earliest date susceptible crops can be safely seeded in treated areas. In this way build-up and rate of disappearance of residue in soils can be studied.

Conclusion: Simazin and the related compounds have been tested experimentally on most soils and on the major crops. Simazin is the most active herbicide of the group, giving outstanding performance on most annual broadleaf weeds and grasses as well as on most perennials. Each of the triazines appeared to be selective on one or more crops.

Work is in progress with labeled Simazin to determine the fate of the chemical within the plant and in biological tests to measure residual Simazin in the soil.

[1] Geigy Agricultural Chemicals, Yonkers, New York.

PRE-EMERGENCE WEED CONTROL IN SNAP BEANS, CUCUMBERS, CARROTS, AND ASPARAGUS SEEDLINGS[1] (Abstract)

By S. K. Ries, J. D. Downes, and J. P. Shugars [2]

There is no recommended herbicide which completely satisfies the requirements for weed control in snap beans, cucumbers, carrots, and asparagus seedlings. During the past four years, almost all of the experimental herbicides available have been screened for their effectiveness on snap beans and cucumbers. In 1957, this program was enlarged to include carrots and asparagus seedlings. This program was conducted in Central and Southwestern Michigan with the objective of comparing experimental herbicides with the standard recommended practices. The observations made were weed control and injury ratings, and the effect of treatment on yield when feasible.

Snap beans. The materials and rates which have given commercially acceptable pre-emergence weed control in snap beans without causing injury to the beans are as follows: (1) 1 lb/A of 4-(MCPB) (4 tests); (2) 6 lb/A of EPTC (3 tests); (3) 4 lb/A of CDEC (3 tests). The preceding materials were used also in combinations, and although they were effective, there seemed to be no synergistic effect.

Cucumbers. The sodium salt of N-1-naphthyl phthalamic acid (NPA or Alanap-3) was found to be as effective as N-1-naphthyl phthalamic acid (NPA or Alanap-1). CDEC at 4 lb/A was the only new material tested which gave as effective weed control as NPA without causing injury to the cucumbers (4 tests). CDEC was no more effective than either form of NPA after a heavy rain. The information obtained was not sufficient to determine if this chemical will give better weed control than NPA under dry soil conditions. This latter condition has been the most important limiting factor in the use of NPA.

Carrots. The material and rates which gave commercially practical pre-emergence weed control on mineral soil without causing injury to the carrots were as follows: 1) 1 lb/A of 2-chloro-4-diethylamino-6-isopropylamino-s-triazine (3 tests); 2) 6 lb/A of EPTC (3 tests).

Asparagus seedlings. The following materials gave better weed control, in a single test, than Stoddard solvent and DNBP in asparagus seedlings grown for crown production on muck: 1) 4 lb/A of Simazin; 2) 2 lb/A of monuron; 3) 2 lb/A of diuron; 4) 4 lb/A of 2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine; and 5) 4 lb/A of 2-chloro-4-bis-(isoproylamino)-*s*-triazine.

[1] Approved for publication by Michigan Agricultural Experiment Station.
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CHEMICAL WEED CONTROL STUDIES IN ASPARAGUS PLANTINGS[1]

J. K. Greig and C. V. Hall [2]

No previous work on chemical weed control in asparagus plantings has been done at the Kansas Agricultural Experiment Station. Due to the interest in this subject by fresh market growers, a study was initiated in 1957. Many of the asparagus growers in Kansas use large quantities of manure in growing this crop. Therefore annual weeds are a problem. The habit of growth of this crop prevents the use of cultivating equipment soon after the harvest season is over. Hand

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labor is much too expensive to use on this crop; therefore chemical methods of weed control would be very desirable.

Materials and Methods

Two separate experiments were conducted during the 1957 growing season. The chemical treatments in both cases were applied after thoroughly disking the asparagus plantings. The chemicals in the first experiment were applied on April 19, 1957. Each plot consisted of sixty square feet and the Mary Washington variety was used. The chemicals used and the rates of application were as follows: Check, Crag Herbicide 1 at 3 lb/A, Simazin at 1 lb/A, Karmex W. at 1 lb/A, Alanap 1 at 4 lb/A and Simazin at 4 lb/A. All these chemicals were applied in 90 gallons of water per acre.

The second experiment was conducted across a variety planting. The chemicals were applied on May 29, 1957 after the asparagus harvest season was over. Each plot consisted of 180 square feet. The chemicals used and the rates of application were as follows: Check, Crag Herbicide 1 at 3 lb/A, Natrin at 3 lb/A, Karmex W at 1 lb/A, Alanap 3 at 12 qt/A, Simazin at 1 lb/A, and Simazin at 4 lb/A. All these chemicals were applied in 90 gallons of water per acre.

The effectiveness of the chemicals was measured by counting the broad-leaved and narrow-leaved weeds in a representative 1 square foot area of each plot for each replicate. The counts in the pre-harvest application experiment were made on May 28 and August 15, 1957. The counts in the post-harvest application experiment were made on June 24 and August 15, 1957. In each plot four representative 1 square foot areas were counted for broad-leaved and narrow-leaved weeds. These areas were averaged to get a more-representative count. In addition, asparagus seedlings were counted in the same areas on June 24. Observations on the genera of weeds present and the effect of the chemicals on the asparagus plants were also made.

Data and Discussion

In the pre-harvest experiment, five weeks after the chemicals were applied, the counts showed that all chemical materials used reduced both the narrow-leaved and broad-leaved weeds significantly at both the 5 and 1 percent levels. Seventeen weeks after application another count was made to measure the residual effects. At this date there was no significant difference in the number of broad-leaved weeds present. Only Simazin at both rates of application showed a significant difference from the check treatment in the number of narrow-leaved weeds per treatment. The only visible damage to the asparagus plants due to the chemicals used was a reduction in fern growth on the high rate of Simazin. The weeds present in the check plot were: marestail *(Erigeron canadensis)*, pigweed (*Amaranthus* spp.), lambsquarters *(Chenopodium album)*, spurge *(Euphorbia* spp.), climbing milkweed *(Ampelamus albidus)*, three-seeded mercury (*Acalypha* spp.), crabgrass *(Digitaria sanguinalis)*, foxtail *(Setaria lutescens)*, barnyard grass *(Echinochloa crusgalli)* and stinkgrass *(Eragrostis cilanensis)*. The effects of the chemicals on the narrow-leaved and broad-leaved weeds for the post-harvest experiment both 4 and 12 weeks after application were studied. The effect of the chemicals on volunteer asparagus seedlings was also determined four weeks after application. All chemicals used reduced the number of narrow-leaved weeds significantly at the 1 percent level except Crag Herbicide. It was significant only at the 5 percent level. All chemicals except Crag Herbicide reduced the number of broad-leaved weeds significantly at the 1 percent level. There was no significant difference between the check and the Crag Herbicide treatment. There was no significant difference in the number of asparagus seedlings per treatment. The counts made 12 weeks after application showed that all chemicals used reduced the number of narrow-leaved weeds at the 5 percent level. Karmex W, Alanap 3, and both rates of Simazin also reduced the number of narrow-leaved weeds significantly at the 1 percent level. The only visible injury to the asparagus plants from the use of the chemicals was a reduction in fern growth on those plots treated with Simazin at the rate of 4 lb/A. The fern growth was higher on the stems in all plants where this treatment was used. The weeds present in the check plots in this experiment were: pigweed (*Amaranthus* spp.), spurge (*Euphorbia* spp.), lambsquarters *(Chenopodium album)*, climbing milkweed *(Ampelamus albidus)*, wild vetch (*Vicia* sp.), puncture vine *(Tribulus terrestris)*, sandbur *(Cenchrus pauciflorus)*, crabgrass *(Digitaria sanguinalis)*, foxtail *(Setaria lutescens)*, stinkgrass *(Eragrostis cilanensis)*, and barnyard grass *(Echinochloa crusgalli)*.

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COSTS OF WEEDING ONIONS WITH AND WITHOUT HERBICIDES (Abstract)[1]

R. E. Nylund, D. C. Nelson, and D. H. Dinkel [2]

Comparisons of costs of weeding muckland onions with and without herbicides were made in 1956 and 1957. In 1956, herbicides used were 1.6 lb/A monuron, 8 lb/A CIPC, and a mixture of 0.8 lb/A monuron plus 4 lb/A CIPC. Each of these were applied three times to the same onion plots as a pre-emergence treatment and two post-emergence treatments. One set of plots sprayed with the herbicide was weeded when necessary and one set was left unweeded except for normal cultivation. Weeded and unweeded checks were also included. To obtain data on labor costs, all hand-weedings were timed with a stopwatch.

In 1957, monuron at 1.6 lb/A, CIPC at 8 lb/A, and CDAA at 4 lb/A were applied pre-emergence to two sets of plots and at lay-by to one of the two sets previously sprayed. All plots, including an unsprayed check, were handweeded when necessary. Labor costs were again determined by timing the hand-weeding in each plot.

Labor required to hand-weed onions was 170 hours per acre in 1956 and 111 hours in 1957. At prevailing wage rates, the weeding cost, exclusive of cultivation costs, was $127 and $83 per acre for 1956 and 1957, respectively.

In 1956, monuron applied three times at 1.6 lb/A reduced weeding time 70 percent and weeding costs 50 percent. CIPC applied three times at 8 lb/A reduced weeding time 37 percent but did not reduce weeding costs. The mixture of monuron and CIPC reduced weeding time 54 percent and weeding costs 26 percent.

In 1957, single (pre-emergence) and double (pre-emergence and lay-by) applications of 1.6 lb/A monuron, 8 lb/A CIPC, or 4 lb/A CDAA reduced weeding time by approximately 50 percent. A single application of herbicides reduced weeding costs 34 to 40 percent, but a second application did not reduce costs further.

In neither year did the herbicide treatments significantly affect onion yields.

In 1956, onions sprayed three times with herbicides but not hand-weeded produced 390 bushels of marketable onions per acre. Onions similarly sprayed but handweeded to remove the remaining weeds produced 849 bushels per acre. Onions neither sprayed nor weeded produced no marketable crop.

[1] Abstract of Paper No. 3828, Scientific Journal Series, Minnesota Agricultural Experiment Station. To be published in full elsewhere.
[2] Department of Horticulture, Minnesota Agricultural Experiment Station.

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STUDIES ON THE CONTROL OF WEEDS IN TRANSPLANTED TOMATOES (Abstract)

G. F. Warren [1]

As yet no truly selective herbicide has been found that will control a majority of the important weeds found in Indiana tomato fields without causing damage to the crop. Attempts have therefore been made to use such factors as depth protection and lack of direct injury to tomato foliage to try to obtain satisfactory results. Experimental work carried on for the past four years has indicated some of the approaches that might be taken in the future which may lead to practical methods of control if truly selective materials are not found in the meantime.

An herbicide that caused no direct injury to the tomato foliage, was active in killing germinating weeds and was highly resistant to movement in the soil would seem to offer possibilities. The herbicide 2,4,5-TES (Natrin) satisfies the first two of these requirements but on light soils, and with high rainfall, even on heavy soils, it has leached to the tomato root zone and caused severe injury. Studies with 2-chloro-4,6-bis-(ethylamino)-*s*-triazine (Simazin) showed that this herbicide was not absorbed through tomato foliage. Unfortunately, it also moved into the root zone and was taken up by the tomato plants causing severe injury or death in all the experiments.

Neburon showed a great deal of promise for weed control in tomatoes in 1956 but in 1957 caused considerable injury in some experiments. Greenhouse work indicated that most if not all of the injury came from absorption through the foliage since the material was very resistant to movement even in a light sandy soil but could be absorbed directly by the foliage.

In view of these results it is suggested that materials such as neburon might be successful if applied in a granular form to avoid direct injury to the foliage. The experimental results also indicate that CDAA and probably certain other herbicides should be tried on this crop in granular formulations.

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RESPONSE OF CROPS AND WEEDS TO SEVERAL GRANULAR HERBICIDES

W. Welker, R. Taylorson, F. Gilbert, M. Dana and L. Holm [1]

The relative activities of herbicides when applied in granular and liquid formulations have not been satisfactorily summarized to date, nor do we have anywhere a precise outline of the places in our cultural programs where these materials may be used most effectively. With this in mind, several members of our group set out to acquaint themselves with the problems in the application of these new materials, and to become familiar with the responses of horticultural crops, and of weeds, in several very different situations. We used eight chemicals; some were on vermiculite and some were on clay. They were applied pre-emergence to snap beans and red beets, post-emergence to year-old seedling transplant conifers, newly-set strawberries, and established cranberries. The conifers were Scotch pine Douglas fir, arbor vitae, and blue spruce. The strawberries included the varieties Catskill, Robinson, and Sparkle. The experiments with beans and beets were on a silt loam soil, the strawberries and conifers were on a sandy loam soil while the cranberries were on a peat with some sand mixed at the surface. Each experiment was carried out at a different location in the state and each was initiated at a different date. All applications were made with a hand fertilizer spreader which was carefully calibrated for the various types of materials used. Estimates on crop injury and weed control were obtained by recording visual observations. In most instances reported here, an identical plot was *sprayed* at 40 gpa with the same chemical at the same rate.

The dominant weed species present in the experiments on snap beans, beets, conifers and strawberries were pigweed (*Amaranthus retroflexus*), lambs-quarter (*Chenopodium album*), and foxtail (*Setaria* sp.). The dominant species in the cranberry experiment were common ragweed (*Ambrosia artemisiifolia*), smartweeds (*Polygonum* sp.), and sticktites (*Bidens* sp.).

The following is a summary of the performance of the chemicals. All of the rates are in pounds of active material per acre.

EPTC (ethyl-N,N-di-*n*-propylthiolcarbamate) was applied at 4 and 8 lb on beans and beets. There was no crop injury and no weed control.

CDAA (2-chloro-N,N-diallylacetamide) was applied at 4 and 8 lb on beans and beets, 5 lb on conifers and 10 lb on strawberries. The injury varied from moderate to severe on beans and beets with good weed control to no injury and no control on conifers and strawberries.

CIPC (isopropyl N-(3-chlorophenyl)carbamate) was applied at 8 and 16 lb on beans and beets. The conifers received 8 lb while the strawberries received 5 lb. The injury was severe on beans and beets, none on conifers and slight on strawberries. The weed control was very good on the beans and beets and good on conifers and strawberries.

Simazin (2-chloro-4,6-bis(ethylamino)-*s*-triazine) was applied at 1 and 2 lb on beans and beets, 2.4 lb on strawberries, 1 lb on conifers and 2 and 4 lb on cranberries. The injury ranged from severe on beans and beets to none on conifers, strawberries and cranberries. The weed control was very good in all cases except on conifers.

DNBP (4,6-dinitro ortho secondary butylphenol) was applied at 8 and 16 lb on both beans and beets and 5 lb on strawberries. In all cases the injury was severe while the weed control ranged from good on strawberries to very good on beans and beets.

Endothal (3,6-endoxohexahydrophthallic acid) was applied at 8 and 16 lb on beans and beets. The injury was slight on beets and severe on beans. The weed control was very good.

Diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea) was applied at 1 and 2 lb on beans and beets and 2 lb on conifers. There was no injury on conifers, moderate injury on beams and severe injury on beets. The weed control ranged from good on conifers to very good on beans and beets.

CDEC (2-chloroallyl diethyldithiocarbamate) was applied at 4 and 8 lb on beans and beets and 5 lb on strawberries. Strawberries showed no injury, beans showed slight injury while beets showed moderate injury. The weed control ranged from none in strawberries to good in beans and beets.

A post-emergence experiment was conducted on snap beans and beets. The chemicals used were those reported for these two crops in the pre-emergence experiments above. The granulars were applied when the first true leaves were fully expanded. The beets were 6 to 8 inches tall at this time. DNBP and CIPC caused burn-

ing of the leaves within 48 hours. Snap beans showed typical Simazin and diuron injury within 10 days. No other injury was noted. The control of weeds already up was poor and the control of weeds that had not emerged at the time of application was about the same as in the pre-emergence experiments.

The residual effect of almost all the chemicals was surprisingly long. Even the DNBP and CIPC plots were essentially clean at the end of the growing season. Many of the chemicals were two or three times more effective in controlling weeds in this form than when applied in spray form. The granular formulations were often more toxic to the crop plants.

In several years granular herbicides have been reported to be particularly effective for specific uses in the management of our crops. Our experiments this season have shown that they may at times be highly toxic to crops and weeds and that they may be effective for long periods. The larger question seems to be, "In which situations can they successfully compete with spray formulations?" In the near future, this seems hardly likely in pre-emergence work. In post-emergence work, in our experiments, the crops which are most tolerant of sprays were also most tolerant of granulars. There is, however, a greater tolerance in most cases to the granulars when applied post-emergence than to the same material applied as a spray.

[1] University of Wisconsin, Madison, Wisconsin.

WEED CONTROL IN ESTABLISHED AND NEW STRAWBERRY PLANTINGS[1]

D. D. Hemphill [2]

During the period 1950-1952 an extensive evaluation of herbicides for weed control in strawberries was carried out. These studies indicated that 2,4-D and 2,4-DES (sodium 2,4-dichlorophenoxyethyl sulfate) were the most satisfactory herbicides available under the conditions of these experiments.

Since this time the use of dinitros and liquid and granular formulations of CIPC for the control of fall-germinating grasses and broad-leaved weeds, which can not be controlled satisfactorily by a late fall application of 2,4-D, has been studied.

A serious problem that is not readily solved by presently recommended herbicides is the germination of weeds, particularly crabgrass, during the harvest season.

Established Plantings

On April 2, after mulch removal and growth of the strawberry plants had resumed but before the plants had begun to bloom, 2,4-DES, CDAA, EPTC (ethyl-N,N-di-n-propylthiolcarbamate), 3Y9 (tris-(2,4-dichlorophenoxyethyl) phosphite), Simazin and G-27901 (2-chloro-4-ethylamino-6-diethylamino-s-triazine) were applied to a planting of Ardmore strawberries in an effort to control weed germination until after harvest.

Treatments and results are shown in Table 1. All treatments except 2,4-DES resulted in excessive injury to the foliage of the strawberry plants and reduced yields. Although 2,4-DES did not cause any appreciable foliage injury or yield reduction considerable crabgrass germination resulted prior to the end of the harvest season.

Under the conditions of this experiment none of the herbicides appeared promising.

Table 1. Evaluation of Herbicides for Control of Weed Germination During the Harvest Period.

Treatment	Weed control	Injury	Yield, crates/A
Control			273
2,4-DES 6 lb/A	Inadequate	Slight if any	261
Simazin 2 lb/A	Excellent	Chlorosis, stunting	142
G-27901 4 lb/A	Excellent	Chlorosis, stunting	197
CDAA 12 lb /A	Excellent	Severe leaf burn	183
EPTC 10 lb/A	Satisfactory	Severe leaf burn	178
3Y9 4 lb/A	Satisfactory	Leaf burn, modification	202

New Plantings

During the summer the same herbicides except Simazin were compared with 2,4-DES for weed control in a new planting of Dixieland strawberries. The plants were set in late March and weeds were controlled by a mechanical hoe until runners began to set and weeds within the row could no longer be controlled by mechanical methods.

The first application of herbicides was made to clean plots on June 24. Weed counts were made on July 26 after which all weeds were removed and a second application of herbicides was made on August 13. Effectiveness of treatments on weed control and effects on runner production are shown in Table 2.

Table 2. Effects of Herbicides on Weed Populations and Strawberry Runner Production — 1957.

Treatment	Weeds sq. ft. BL	Weeds sq. ft. NL	Effect on strawberry plants	Runner plants per mother plant
Control	2.0	14.0		33.9
G-27901 4 lb/A	0.3	4.3	None evident	32.1
EPTC 6 lb/A	0.5	7.0	None evident	36.7
3Y9 4 lb/A	1.3	0.6	None evident	30.4
CDAA 6 lb/A	2.0	1.3	Slight leaf burn 1st. treatment	29.1
2,4-DES 4 lb/A	1.6	0.3	None evident	28.6

Many of the broad-leaved weeds were perennials such as trumpet creeper and bindweed—control of which would not be expected by pre-emergence treatments. EPTC and G-27901 did not give as adequate control of crabgrass as desired but runner production indicated that there was no serious competition by the crabgrass.

Conclusions

The problem of weed germination during the harvest period was not solved satisfactorily. The new strawberry foliage appears very subject to injury for a period of time after growth is resumed in the spring. Applications of herbicides before growth is initiated may eliminate or greatly reduce this injury. Where crabgrass is the primary problem, later application, even after bloom, may offer a possibility of success.

For new plantings, all herbicides compared with 2,4-DES were promising enough to warrant further testing. None were strikingly superior to 2,4-DES in overall performance; however, all tended to suppress runner production less than 2,4-DES.

[1] Contribution from the Missouri Agricultural Experiment Station, Journal Series No. 1817. Approved by Director.

[2] Missouri Agricultural Experiment Station, Columbia, Mo.

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CRABGRASS CONTROL IN ESTABLISHED STRAWBERRY PLANTINGS[1]

Ronald W. Campbell [2]

A preliminary report on the control of common crabgrass in established strawberry plantings by the use of selected chemicals was made by Campbell and Atteridg [3]. These studies were continued during the summer of 1957 with some of the most promising materials of the 1956 study being included as well as a few new chemicals.

Materials and Methods

The chemical treatments were made as residual preemergence applications to a third year planting of Blakemore plants after the rows were narrowed to 12 inches following harvest. Each of four replicated plots was sprayed July 26 and August 26 with one of the materials tested. Irrigation was provided as needed during the season.

Eight chemical treatments were made. These included 3-(3,4-dichlorophenyl)-1,1-methylurea (neburon) at 4 lb/A, sodium 2,4-dichlorophenoxyethyl sulfate (sesone) at 4 lb/A, 2,4-dichlorophenoxyacetamide (Emid) at 2 lb/A, tris-(2,4-dichlorophenoxyethyl) phosphite (3Y9) at 1½ gal/A, 2-chloro-4,6-bis(ethylamino-*s*-triazine (Simazin) at 1 lb/A and 2 lb/A, Geigy 27901 at 2 lb/A and 4 lb/A.

Counts were made of the crabgrass seedlings in a 2 foot square sampling area of each treated and untreated replicate 3 weeks after date of spraying. Data on the visible effect of the materials on the strawberry plants were taken for 3 weeks after each spray application.

Data and Discussion

It can be seen from Table 1 that a number of chemical materials gave excellent control of the crabgrass seedlings as indicated by the number of live seedlings per sampling area.

It was found on August 16, three weeks after the first spray application, that the chemicals reduced the number of crabgrass seedlings when compared with the check plots as follows: Simazin at 1 and 2 lb/A—100% each; Geigy 27901 at 2 lb/A—100%; at 4 lb/A—99%; neburon—98%; 3Y9—94%; Emid—90%; and sesone—24%. There was severe injury to the strawberry leaves as a result of the Simazin applications at 2 lb/A; many of the younger leaves were killed and runner production was inhibited for about three weeks. Some injury to the leaves was noted on the plants sprayed with Simazin at 1 lb/A, Geigy 27901 at 4 lb/A, and neburon. Margins of some of the leaves sprayed with the first two materials were necrotic while some chlorosis was observed on the leaves of the plants sprayed with neburon. The chlorosis was slight and had disappeared within two weeks. None of the plants sprayed with 3Y9, Emid or sesone showed any foliage injury. The weather was quite hot for nearly a week following the first spray application.

September 16 the reduction of crabgrass seedlings by the second application of the various spray treatments was found to be Simazin 1 and 2 lb/A—100%; Geigy 27901 1 lb/A—99%; 4 lb/100%; neburon—100%; 3Y9—95%; Emid—95%; and sesone—42%. The plants sprayed with Simazin at 2 lb/A showed strong reaction, nearly 75% of the plants being killed and those alive were stunted and burned. None of the other chemical treatments visibly affected the foliage. The weather was considerably cooler during the three weeks following the second spray application than during a similar period after the first application.

Table 1. Average reduction in percent of crabgrass seedlings as compared with unsprayed check plots.

		Percent control of crabgrass and effect on strawberry leaves			
Material	Rate lb/A	Aug. 16	Visible leaf injury	Sept. 16	Visible leaf injury
1. Simazin	1	100	Light	100	None
2. Simazin	2	100	Severe	100	Severe
3. Geigy 27901	2	100	None	99	None
4. Geigy 27901	4	99	Light	100	None
5. Neburon	4	98	Light	100	None
6. 3Y9	2	94	None	95	None
7. Emid	2	90	None	95	None
8. Sesone	3	24	None	42	None

The counts are averages of seedlings found in replicated 2-foot-square sampling areas for each treatment.

[1] Contribution No. 269, Department of Horticulture, Kansas Agricultural Experiment Station, Manhattan.

[2] Associate Pomologist, Kansas Agricultural Experiment Station.

[3] NCWCC 1956 Proceedings, pp. 62-63.

CHEMICAL WEED CONTROL STUDIES IN YOUNG VINEYARDS (Abstract)

C. C. Doll[1]

The use of chemicals for controlling weeds in the row of mature vineyards is becoming resolved. This is possible because of either a protective covering of old bark on the trunk or the treatment of only a small portion of the total root zone of a mature vine. The use of similar chemicals in newly planted vineyards and those not of bearing age is limited because of lack of this protective covering of bark or because the treatment area involves such a large percentage of the root zone of the small plants. This study concerns the use of three preemergence herbicides and their effects on young grape vines.

Treatments were made on a newly planted Fredonia vineyard and on an established vineyard of two-year old Concord plants. The soil was an Ida silt loam, a loess soil low in organic matter, sand, or clay particles, and very uniform in texture and depth. Chemicals used were diuron, Simazin and CIPC. Rates per acre (active ingredients) were diuron at 1, 2, and 3 lb in the Fredonia vineyard and 1, 2, 3, and 4 lb in the Concord vineyard; Simazin at 2 and 4 lb in both plantings; and CIPC at 14 lb in both plantings. Chemicals were applied in a 24-inch band in the row with a knapsack sprayer. Check plots were untreated except for sufficient hoeing to control weeds within a 12-inch radius of the plants. Applications were made on April 27, 1957. Growth determinations were made in the fall by weighing the shoot growth produced in 1957.

Resultant weed control from the use of diuron, Simazin and CIPC was similar in both vineyards. The differences in the growth of the vines as determined by weight were the only distinguishing characteristics between the vineyards. In the Fredonia vineyard, the 1-pound rate of diuron was the only significantly different treatment as compared with the check. In the Concord vineyard, the 1-pound diuron treatment was

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equal to the check plots in plant growth. In this vineyard, the 3-pound rate of diuron gave the only significant increase in plant growth as compared with the check. Although growth of vines from the CIPC plots was not significantly different from the check vines, they made less growth and appeared to be stunted. This was first observed eight weeks after application when the leaves showed marginal burning and were slow to recover. Mottled chlorosis of leaves appeared June 29 on all vines treated with either diuron or Simazin. This injury followed 11 inches of rain that carried the chemicals into the root zone. Injury disappeared by the end of the season in the 1-pound diuron plots. All other vines showed chlorosis throughout the season, the higher rates producing the more severe symptoms. Some dropping of basal leaves in August occurred where the maximum rates were applied. In all treatments, mature wood appeared normal.

Principal weeds were yellow foxtail *(Setaria lutescens)* and fireweed *(Kochia scoparia)*, both annuals. Control of these weeds with diuron and Simazin was excellent. The 1-pound rate of diuron was about 75 per cent effective for the entire season, whereas the other diuron and both Simazin treatments were 90 to 100 per cent effective against these weeds. CIPC was effective for about 60 days, becoming ineffective for the remainder of the season. All treatments caused some burning and stunting of a few perennial weeds present in the plantings. However, the concentrations of chemicals used in these studies did not kill the perennials.

[1] Assistant Professor, Horticulture Department, Iowa State College.

CHEMICAL WEED CONTROL IN GARDEN CHRYSANTHEMUMS[1]

R. J. Stadtherr and R. E. Widmer[2]

Weed control trials were conducted from 1955 through 1957 in a clay-loam soil on the St. Paul Campus. This area had been planted to chrysanthemums (*Chrysanthemum morifolium* Ram.) for 20 years and was infested primarily with *Portulaca oleracea* L., *Setaria* sp., *Digitaria* sp., and *Amaranthus retroflexus* L.

Chemicals were applied to replicated and randomized 3 x 8-foot plots, each containing four chrysanthemum plants. Well-rooted young plants from 2½" containers were planted in the field at a 2 x 3-foot spacing. All herbicides were applied at 30 psi using a knapsack sprayer. Spray was directed, as much as possible, so as to avoid contact with the chrysanthemums. With the exception of Stoddard solvent and the soil sterilants, all herbicides were applied in 120 gallons of water per acre.

Weed counts were made when the weed populations in some treatments appeared to give excessive competition to the chrysanthemums. The effectiveness of the chemical treatments was determined by counting the weeds in a one- by six-foot area in the center of each plot. The most effective materials from each year's trials were compared with other promising herbicides for the succeeding year's trials.

Preplanting treatments of sodium-N-methyl dithiocarbamate (Vapam) at ½, 1 and 1½ qt and 3,5-dimethyltetrahydro-1,3,5,2H-thiadiazine-2-thione (Mylone) at ½, ¾ and 1 lb per 100 sq. ft. were applied in the two year period. Both were highly successful in reducing the weed population for at least four to six weeks. Black plastic (1½ mil thickness) as a mulch was highly effective in one year's test. Plants were about 25% smaller in these plots and the controls compared with plants in the Vapam and Mylone treated plots.

Eleven different post-planting chemicals were used over the three year span. These herbicides and rates used in pounds per acre were: sodium 2,4,5-trichlorophenoxyethyl sulfate (2,4,5-TES) (85% active) at 2; sodium 2,4-dichlorophenoxyethyl sulfate (2,4-DES) (90% active) at 2, 4 and 6; 3-(3-chlorophenyl)-1,1-dimethylurea (monuron) (80% active) at ½ and 1; potassium cyanate (KOCN) (90% active) at 8 and 12; isopropyl N-(3-chlorophenyl) carbamate (CIPC) (47% active) at 4, 6 and 8; N-1-naphthyl phthalamic acid (NPA) (90% active) at 4; 2-chloro-4,6-bis(ethylamino)-*s*-triazine (Simazin) (50% active) at 1 and 2; 2-chloro-4,6-bis(diethylamino)-*s*-triazine (chlorazin) (49.5% active) at 2 and 4; ethyl-N,N-di-*n*-propylthiolcarbamate (EPTC) (87% active) at 5; disodium monomethyl arsonate (DSMA) (19.2% active) at 8,and 2-chloro-N,N-diallylacetamide (CDAA) (47.7% active) at 4. Three combinations were used: NPA at 2½ plus 2,4-DES at 2½; monuron at ½ plus 2,4-DES at 4; and CIPC at 4 plus TCA (90% active) at 6.

The most effective treatments which were used in all three years included: monuron at 1 lb/A, monuron plus 2,4-DES, and CIPC at 6 or 8 lb/A. These treatments are recommended for post-planting chemical weed control in garden chrysanthemums. A combination of CIPC plus TCA was quite good in two years' trials. CDAA gave good control in a single year's test.

[1] Paper No. 3870, Scientific Journal Series, Minnesota Agricultural Experiment Station.

[2] Instructor and Assistant Professor, respectively, Department of Horticulture, University of Minnesota, St. Paul 1, Minnesota.

WEED CONTROL IN LINING-OUT STOCK OF FOUR SPECIES OF ORNAMENTALS[1] (Abstract)

by S. K. Ries and Donald P. Watson[2]

Since 2,4-DES, NPA, monuron, and mixtures of these materials have been shown to be effective herbicides in nurseries, the present study was designed to compare these treatments and other herbicides for lengthening the period of effective control of annual weeds without causing injury to young plants in a nursery.

Materials and Methods

Two-year-old lining-out stock, 12 to 18 inches high, of *Cotoneaster acutifolia*, *Syringa rothonagensis*, *Taxus cuspidata capitata* and *Taxus media hicksi* was transplanted in a Hillsdale fine sandy loam on June 4 and 5, 1957, in a randomized block with three replications. The area was irrigated on June 5 and the treatments applied two days later in 21 gal/A of water as an overall spray at a pressure of 25 psi.

Results

The weed control and injury ratings were made on July 15. As shown in Table 1, commercially acceptable weed control without causing significant injury to any of the species in the test was obtained by the following: 4 lb/A of 2,4-DES, 2 and 4 lb/A of Simazin, and the combination of 4 lb/ of NPA and 4 lb/A of 2,4-DES.

The average injury ratings for all chemicals on the different species are presented in Table 2. Lilac was the most susceptible, and *Taxus media hicksi* the most resistant species.

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Table 1. Weed Control and Injury Ratings of Treatments Applied to Four Species of Ornamentals.

Chemical	Rate lb/A act. ingr.	Ratings: Weed control[1] (Avg. of 3 observations)	Ratings: Injury[2] (Avg. of 12 observations)
None	—	1.0	1.0
2,4-DES	4	6.7**	1.3
NPA	4	4.0**	1.2
Monuron	1	7.0**	2.8
Diuron	1	7.7**	4.1**
Simazin	2	8.7**	1.3
Simazin	4	8.7**	1.2
EPTC	6	5.3**	1.9
CDEC	4	3.0	1.1
ATA	6	7.3**	4.8**
Diuron + 2,4-DES	1 + 4	7.7**	4.4**
NPA + 2,4-DES	4 + 4	8.0**	1.5
Dalapon	5	3.7	1.1
Dalapon + diuron	5 + 1	8.3**	3.8**
L.S.D. at 5%		2.0	1.5
L.S.D. at 1%		2.9	2.0
Coefficient of variation		21%	22%

[1] Weed control rating scale: 1.0 = no control, 6.0 = commercially acceptable control, 9.0 = eradication.
[2] Injury rating scale: 1.0 = no injury, 9.0 = complete kill.
** Vary significantly from no treatment at 1% level.

Table 2. Average Injury Ratings From all Treatments in the Various Species.

	Injury ratings[1] (Avg. of 45 observations)
Taxus media hicksi	1.53
Cotoneaster acutifolia	1.72
Taxus cuspidata capitata	2.45
Syringa rothonagensis	2.64
L.S.D. at 5%	.32
L.S.D. at 1%	.42
Coefficient of variation	39%

[1] Injury rating scale: 1.0 = no injury, 9.0 = complete kill.

Summary. Fourteen different treatments, including nine herbicides, were applied to four species of ornamentals. The best herbicide tested was Simazin applied three days after transplanting at 2 and 4 lb/A. This material effectively controlled weeds for the entire season without causing any injury to the four species tested. Further testing and a longer period of observation will be necessary to verify the complete role of this material in nursery management.

Although the four species responded similarly to all chemicals, there was a variation in their tolerance to the toxic materials. The difference in susceptibility between the two species of *Taxus* was outstanding.

[1] Journal Article 2173 from the Michigan Agricultural Experiment Station.

[2] Department of Horticulture, Michigan State University, East Lansing, Michigan.

WEED CONTROL IN NURSERY PLANTINGS

(Abstract)

Leroy Holm,[1] Ray Taylorson,[1] and Thomas Pinney[2]

This summary is concerned with the extension of our work of several years with small conifer transplants, and in particular, emphasizes our findings with new herbicides when used alone or in mixtures with other chemicals. These experiments included granular herbicides; the data on these latter experiments will be presented elsewhere in this volume.

The environment in which these experiments took place was briefly this: replicated experimental plots or beds, 4 x 10 feet in size, were prepared in early spring with single rows of seedling transplants of the following species: Scotch pine, Douglas fir, arbor vitae, blue spruce, and alpine currant. All weeds were removed from treated and control plots before spraying on May 15 and July 18. The herbicides used in the experiment, which are set forth in Tables 1 and 2, were applied as an over-all spray with a bicycle-type sprayer at 40 gpa and 30 psi. Wisconsin had one of the wettest springs on record. It may be seen from Table 1 that Simazin (2-chloro-4,6-bis(ethylamino)-*s*-triazine), and mixtures of diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea) and dalapon (2,2-dichloropropionic acid) gave very satisfactory weed control. Diuron and dalapon alone were not as effective. CDAA (2-chloro-N,N-diallylacetamide) and sesone (sodium 2,4-dichlorophenoxyethyl sulfate) have not been of significant help either alone or in mixtures. These areas were very weedy and contained both annual and perennial broad leaves and grasses.

It is well to remember that these early sprays were applied before bud-break and thus found the conifers in a most tolerant condition. Our data on crop response are always taken one full year after treatment but our observations to date may be summarized thus:

1. Diuron injured only alpine currant
2. Simazin injured pine slightly
3. Dalapon injured pine slightly
4. CDAA and sesone gave no injury

Table 1. Weed Control in Conifers—Early (1957)

Treatment (lb/A)	Weed control (pct., July 18)
Simazin 1	79
Simazin 2	95
CDAA 4	43
CDAA 4 + dalapon 5	85
CDAA 4 + diuron ½	67
Dalapon 5	77
Diuron 1	72
Diuron ½ + dalapon 5	92
Diuron 1 + dalapon 5	97
Diuron ½ + sesone 4	64
Diuron 1 + sesone 4	82

The worthwhile plots were cleaned and sprayed in mid-summer. The weed control in these areas in September is presented in Table 2. The results are very similar to those of early season.

Table 2. Weed Control in Conifers—Late

Treatment (lb/A)	Weed control (pct., Sept. 26)
Simazin 1	74
Simazin 2	82
Diuron 1	55
Dalapon 5	47
Diuron ½ + dalapon 5	71
Diuron 1 + dalapon 5	92
Diuron ½ + sesone 4	57
Diuron 1 + sesone 4	77

Other experiments this season, which were carried out under normal nursery management practices and on a large scale, have provided information about the necessity for both components of herbicidal mixtures, as well as the effectiveness of dalapon and diuron in controlling quack grass in new plantings. Several rates of diuron and of sesone were mixed in all possible combinations

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and applied to Norway spruce in a very weedy area. Each rate of each chemical was used alone also. The necessity for having both diuron and sesone present is demonstrated in the slides (which were shown). Adding a small amount of dalapon to this mixture made it much more effective.

A mixture of dalapon and diuron was very effective in suppressing quack grass in first year plantings of several spruce varieties. No injury was incurred if treatments were made before bud-break. Later in the season some spruce varieties were injured following treatment with the same mixture.

In summary:

1. Simazin and mixtures of diuron and dalapon were very effective in these experiments on young conifers.
2. The necessity for both components of the diuron-sesone mixture has been demonstrated.
3. The dalapon-diuron mixture was effective for suppression of quack grass in first year plantings.

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[2] Evergreen Nursery, Sturgeon Bay, Wisconsin.

IOWA FARMERS' DAY

PANEL DISCUSSION: WEED CONTROL AND RELATED PROBLEMS

Moderator: Sig Bjerken

Panel Members:

George Eason, Chairman, State Soil Conservation Committee

(No abstract of his remarks received.)

Val Racek, Farmer and Spray Operator, Huxley, Iowa

I have been asked to share some of my experiences in spraying weeds with herbicides, including field, fence row, and roadside applications. In most cases these practices have given splendid results and the satisfaction of a job well done for ourselves and neighbors alike. Every generation as far back as we can remember and more, has had the job of cutting, mowing, cultivating, and plowing down weeds and still the weed problem is with us. Today with the new herbicides available to farmers, killing weeds by spraying has become a real challenge, to use them, both to destroy or kill the weeds, and just as much from a labor saving angle. I do not know of anything that has helped drive the young men off the farm as much as the old scythe. We used to spend 7 to 10 days cutting weeds on our farm. I doubt very much if we spend one day doing that job now and that is around lots and buildings where we do not want to kill our shrubs and flowers.

It is ten years since we started spraying in a small way. I remember the first time we took a knapsack sprayer, along one of our fence rows well covered with wild hemp. The results were unbelievable. From that time on we have been doing more spraying each year. The old scythe has been used very little since. Our experience along the fence row was so good that I decided to help the wife in the garden. I was careful not to spray on the vegetables but I hadn't learned about fumes, drift and what potential killing power these chemicals really had. Most of you know what happened. I not only killed some of the vegetables but nearly all the Concord grapes, other berry bushes and raspberries in the garden. While this job of spraying did not turn out so good it could have been worse; and taught us a good lesson to watch fumes and drift in later years.

The following year we bought a trailer sprayer. With more information from our extension service at Iowa State College and learning to **read** and **understand** the directions on a container we were able to do a better job of controlling weeds, thereby using our sprayer more and more effectively. Quite a number of years ago our County put in a new grade past our farm. The following spring I broadcast a mixture of oats and brome grass along the roadside. For several years there was real competition from weeds and they had to be cut with the scythe because of the steep grades and narrow ditch. With the use of these new weed killers we now have nearly a 100% weed free roadside and a beautiful stand of bromegrass on the bank as you saw in the pictures. The few dollars we spent for grass seed and herbicides have returned big dividends to us and for the proof of it I welcome you to come and see it anytime. I cannot help putting in a plug for our Story County Supervisors and Weed Commissioners who embarked on a county-wide weed eradication program two years ago. This is their second year covering all but primary roads with herbicides and the results are gratifying and a fine sight to see. I wish to compliment them for the fine work they are doing.

Four years ago we bought our first Hi-Boy sprayer and two years later a second one. With the operation of these sprayers we purchased a truck and large tank to serve as our water supply. In nearly every case the farm supply of water is inadequate or not clean so we furnish water from our own well or buy it in town where we happen to be spraying. Up to this year we have used these sprayers to apply herbicides, DDT, Aldrin, Dieldrin and several other insecticides around the buildings.

Getting back to our farm we do very little fall plowing due to the lay of the land and using the stubble fields for fall pasture. We do control erosion and run off to a certain extent by so doing but we also give weeds a chance to go to seed. A good job of spring plowing is a must along with good cultural practices, later including a light application of a weed spray. In this way we have saved soil, moisture, kept our fields reasonably free of weeds, besides growing good crops.

In spraying corn fields on our farm we do not intend to spray for the common broad leaf weeds until after pollination. There are several reasons for this. Certain crosses or hybrids are sensitive to chemicals. We never know what the weather will do so we don't like to take the chance of getting a high wind and break off a big percentage of plants. This is bad enough if it happened in our own fields but would be disastrous to a custom sprayer if it happened for someone else. So far our custom spraying has given good and favorable results with the exception of one fourteen-acre field. This field was sprayed at about eight inches in height. It bent over badly, some nearly flat. These were anxious days for us, and we were quite relieved when the corn came back. The farmer was satisfied and we were happy. I still don't why this happened because I sprayed several other fields the same day without any harmful effect.

The biggest challenge to me comes from the horse nettle and Canadian thistles. How are you going to help a farmer kill horse nettles if he has seeding of them on every acre of his farm? I have done custom spraying on several farms that have them on every acre. I know we can kill these weeds with an intensive spray program but what about saving the crop. I wish I knew how.

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Canadian thistles like horse nettle certainly need a more severe treatment than the common weeds and if we tackle the job together as neighbors, I believe we'd make real headway in doing so. Most of us farmers are ashamed to admit that we have some of these on our farms (if we do have). If we would think of our Weed Commissioners as our friends and advisors rather than law enforcement officials we would make real progress in getting rid of our thistle patches as well as learn how to control other weeds.

We have had good results in killing small patches of Canadian thistle in corn fields,where it didn't matter if a farmer didn't get a crop off a small piece of ground. This is the program we have followed.

1. Plow these patches late fall if possible.

2. Next spring do not work or till the soil, other than to use a harrow or rotary hoe. Plant right through the patch.

3. When cultivating the crop, lift shovels out of ground and leave an area large enough not to cut any thistle roots on the border or edge of the patch.

4. Do not spray until thistles come to the heading stage; then apply a good mixture of 2,4-D and 2,4,5-T. A knapsack sprayer filled with this mixture will go a long way.

5. Wait at least 7 days (10 is better) before cultivating this area. We like to give the foxtail a chance to help smother them.

6. Inspect these patches every 30 to 45 days. Again give a good application on new growth. In September do likewise.

7. If you have been faithful in your follow up program you'll have a 90 to 95% kill the first year and next spring it will be a minor job to finish them off. Better mark these patches in a note book so as not to miss any or in two or three years there'll be more. "Eternal vigilance is the price of liberty" even in killing weeds.

Our main difference in handling the large patches is that in using the large boom sprayer we do not use the 2,4,5-T chemical until after pollination and then only with the drops attached. We used this method or practice on a two acre field and got a good crop of corn and at least a 90% kill.

In closing I wish to say the proper use of herbicides to kill weeds is truly a Godsend to farmers as well as to others working to kill weeds.

Ben Chase, Price County (Wisconsin) Weed Commissioner

(Mr. Chase repeated the talk he gave on Wednesday morning, Page 37.)

John Furrer, Extension Weed Control Specialist, Nebraska

(No abstract of his remarks received.)

Bob Anderson, President, Iowa Association of Weed Commissioners

In Iowa, the County Board of Supervisors and the County Weed Commissioner constitute a complete unit of Weed Control.

As a County Weed Commissioner my area of activity and interest is limited to the 24 mile square area of my county and so are the other Weed Commissioners of our state. And I can tell you that many of our Weed Commissioners look with envy upon some of our sister states who have well organized Weed Control Programs emanating from a state headquarters, working through districts down to the county level.

At meetings such as this and at our Annual State Weed Commissioners Conference one learns that no two counties interpret our weed laws the same, nor conduct their Weed Control Programs the same. Some so different that it is difficult to realize that they are counties in the same state.

We have what is generally considered a very complete Noxious Weed Law in Iowa, depending on the above mentioned officers for enforcement.

The book issued by the Iowa Department of Agriculture on Weed Control devotes eight pages to enumerating the different sections of the Iowa Weed Law. And the last verse on the last page reads as follows:

"Most important part of the weed commissioner's duties is working out cropping programs in cooperation with farm owners and operators that will, over a period of years, destroy large infestations of the noxious weeds, etc." This verse gives us the encouragement to believe that being a good weed commissioner is something else besides being just an officer of the law.

When I was appointed to the office of Weed Commissioner I met the specified qualifications required by our Noxious Weed Law which read, "He must be a person not otherwise employed in the county," but I soon learned that that did not make me an expert.

Some Weed Commissioners appear reluctant to try to cooperate with their Extension Director, seeming to think that each of them is competing for the same job, but I have never felt that way about it. I have enjoyed a very fine working relationship with my Extension Director and also the Vocational Agriculture Instructors in my county. The farmers that they work with are not my problem and the farmers that I work with never seem to go near the Extension Director and there just isn't any problem there. My Extension Director has helped me numerous times with weed identification and I have often discussed my problems with him and he has helped me with a solution. If you have never worked with a Vocational Agriculture Instructor you will be surprised to learn how much he knows about the farms in his area and I have jokingly often called the Vocational Agriculture Instructors in my county, my deputy Weed Commissioners.

We think that some of our finest work together has been to hold night-time Weed Control meetings in eight of the Consolidated schools in my county.

Our Extension Director acted as the Moderator and we divided the following Weed Control subjects between the five Vocational Instructors and myself: 1. Weed Identification; 2. Cultural Practices; 3. 2,4-D; 4. Other Chemicals; 5. Sprayer Calibration. I discussed the Iowa Weed Law. These meetings proved to be very popular among the farmers in my county and the attendance led us to believe that they were very profitable.

I believe that it is the duty of the County Weed Commissioner to develop a good understanding of the problems in his county and use every means that he can to get the farmer interested in working out his own weed problem before resorting to the law. His victories are much greater that way and he creates friends instead of enemies.

Slides were shown of a Canada thistle problem in Buena Vista County. The farmer had five acres of solid Canada thistles and he was receptive to suggestions from the Weed Commissioner. It was decided to place the land in the Soil Bank and treat the infestation with eight pounds of Weedazol in 100 gallons of water per acre. I loaned him the use of the county's 50 gallon nozzles and he drove over the thistles lengthwise and crosswise.

The slides show the thistles before treatment, during

treatment, three weeks after treatment, and 2 months after treatment. The results were so gratifying that the farmer plans to put the same area back in the Soil Bank in 1958 and retreat it with the same chemical.

Don Willette, Custom Sprayer Operator, Delavan, Minnesota

Today in our spraying operations we use 2 Jeep sprayers for grain, 2 high sprayers for corn and 2 drainage ditch sprayers mounted on Jeep pickup trucks.

We have worked with the following weed chemicals since 1946: 2,4-D ester, and amine, MCP amine, brush killer, TCA, Amino Triazole, Randox, Alanap, and dalapon. Also some work with insecticides, DD'T liquid and granular, lindane, Aldrin, chlordane, and heptachlor.

As we look back on the first years of spraying, we recall our meeting the Jeep. We like the Jeep because it is powerful, sure-footed, light weight and fast on the road. The first year we sprayed a great deal on river banks. I remember one bank where we could not drive up until we loaded on 100 gallons of water. Then we could back up the bank. Also the Jeep makes only two wheel tracks in grain fields.

We also recall volume spraying. By volume we mean 100 gallons of water and one quart of 2,4-D and $10 per acre. We needed then trucks with 1000-gallon tanks, which we have now. I believe one of the most important helps in custom spraying today is the nurse truck. We find more and more farmers without adequate water supply. We have lost more time, and that means acres of spraying, by trying to use the water found on the average farm. Cleaning nozzles and changing filters several times while spraying ten acres can cause a serious loss of income.

We now have three trucks each with 1000-gallon tanks, large transfer pumps driven by power take-offs and enough hose so that our trucks can stay on the road and fill a sprayer over the fence.

We did not stay with the 100-gallon nozzle very long, as our supplier stopped in and put on 5-gallon nozzles. Boy, were we happy. Just think, 100 gallons of solution —20 acres. We learned more about using clean water then than ever before. Also, spraying a grain field on a windy day was out. It seemed the spray from a 5-gallon tip did not always go where it was directed on a windy day, causing a kill here, a miss there, and a very dissatisfied farmer. We soon replaced the 5-gallon tip with 10-gallon and have stayed with them up to now.

My first acquaintance with 2,4-D in 1946 was a folder that contained a before and after picture. The before picture showed a fine home with chairs on the porch and a lawn full of dandelions. The after picture showed the dandelions and chairs gone. I believe this folder over-sold 2,4-D as a one-shot thistle killer. Back in '46, the average farmer looked up his thistle patches in the grain fields the last part of June, cut them off so they would not produce seed, and then forgot about them until the next year. Now we came along with this wonder chemical that would do it with one application. Some patches we did just that, while most others were healthier than ever the following year. We did keep the thistles from going to seed. 2,4-D is still the cheapest way to eradicate thistles if it is applied every time there is a new growth during the growing season. We have had very good results with TCA for pigeon grass in flax and sugar beets and use 2,4-D amine or MCP on grain.

Corn Spraying

We like to spray corn twice during the growing season if the field is badly infested with weeds, the first spraying when it is small and the second two to three weeks after the last cultivation. Spraying at last cultivation does not give complete control. Some regrowth and seed production will develop. A great deal has been said about spraying corn during the pollinating period. During our many years of corn spraying we have never stopped spraying during this period. We have had complaints about our corn spraying, especially the spraying we did before pollination, such as breakage of stalks or goosenecking, but in all our years of corn spraying we have never had a complaint regarding poor pollination or reduction in yield.

This past year we sprayed power-dropped corn right after last cultivation. The weeds were as tall or taller than the corn, therefore, we had to spray over the top. The weather was very hot with high humidity. On the second day after spraying we had a very strong wind. This caused ten to fifteen percent breakage and looked bad. We got an excellent weed kill. Question: What would cause the greatest reduction in yield—weeds or spray? Spraying corn from 10 inches high to time of last cultivation worries me more than any other time. Weather is the big factor at this period. I have no information from our experience that would cause us to stop spraying corn during the pollination period.

We use one pint of 2,4-D amine per acre if the sun is shining and the temperature is normal. Under cloudy and lower temperature we increase the chemical per acre. Also the kind of weeds we are spraying controls the amount of chemical.

Drainage ditch spraying for brush, trees and weeds is developing into a summer operation in our county and neighboring counties. Three years ago we built a boom on a Jeep field sprayer. We proved to our county commissioners that ditch spraying could be done with a boom type sprayer. The first year we sprayed ten miles of ditch. This operation got us a contract for the following year to spray all the ditches in our county.

The following winter we bought a Jeep pickup and built our first ditch spraying machine. We have a 200-gallon solution tank. An auxiliary motor operates spray pump and hydraulic pump. A 30-foot boom is controlled by three hydraulic cylinders. This machine needs two operators; one drives the Jeep pickup while the other operates the boom from a rear seat. To aid our boom, the tail gunner has a John Bean gun so he can give the brush and trees an extra helping of solution as we move along.

The spray nozzles on the boom start about seven feet from the Jeep pickup, spaced 20 inches apart on the full length of boom. On the extreme end we use two broad-jet type nozzles. Another operation we are experimenting with is spraying eight feet of the ditch bottom for reed canary grass. Dalapon has held this grass in check for one year. How much longer we do not know. Our county commissioners are very much interested in this experiment. Also this ditch machine works very well on roadsides where you want to spray the fence rows, too.

We have done some work with pre-emergence spraying. Randox has given best results. We feel more research needs to be done with these chemicals. From a custom sprayer's viewpoint, we feel the time for application of these pre-emergence sprays is too short and band spraying with our equipment is economically unsound.

In closing, we like to use same brand of chemicals that we have had experience with over the years, because we know what they will and will not do. A good supply of clean water is of great importance.

We charge so that we make a fair profit. If our work is unsatisfactory, we respray without charge. We feel a good spray operator, under average conditions, should get at least a 90% kill.

We use high pressure for foliage spray, only to get distance with John Bean guns, not to blow solution through bushes and trees.

We believe the custom spray operator is here to stay.

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SAFETY WITH PESTICIDES

H. Gunderson [1]

Whose safety concerns us when we talk about pesticides? It seems to me that there are four groups with whom we must be concerned. (1) The operator: this is the individual who comes in intimate contact, perhaps day after day, with the chemicals used to kill insects, weeds, plant diseases, or rodents. He is the individual most likely to be affected by continued or careless exposure. He may suffer from acute toxicity, chronic poisoning, or the disagreeable side effects of exposure to these various chemicals. These latter effects may include allergic reactions, skin rashes, or respiratory and digestive disturbances. (2) The consuming public: Unwise application of improper pesticides on growing crops or on feed or food supplies may result in a hazard to the consumer. The long-time chronic effects of most modern pesticides are not well known. All precautions should be taken to avoid contamination. (3) Desirable plants: Any of the pesticides which may be applied on crops might cause trouble on susceptible desirable plants. (4) Livestock: Here again we are concerned with acute toxicity from the application of a pesticide directly on the animal, chronic toxicity from the application of pesticides on animals or the contamination of feed supplies by these materials. We are also concerned with chemical changes in taste or odor of poisonous plants as a result of herbicide application. We are also concerned about the residues of pesticides which may be stored in the tissues of animals slaughtered and later consumed as food by the public.

How can we use pesticides safely? (1) Select the proper pesticide. To do this, the farmer or custom sprayer operator must know the recommendations of his state college. In making these recommendations experiment station and extension workers must be familiar with the toxicology of various pesticides, governmental restrictions on their uses, and effectiveness under local conditions. All of these are taken into consideration in making state recommendations. (2) Read, understand and follow directions on the label. Reputable manufacturers spend much time and money in preparing labels on pesticides. These are intended to guide users in the safe application of the material. Failure to follow the label and state recommendations frequently results in unnecessary hazard. (3) Time applications to avoid destruction of desirable (beneficial) plants and insects. An outstanding example of proper use of a pesticide is in the field of alfalfa seed production. It sometimes becomes necessary to apply an insecticide during the bloom period to control a migration of insects into the seed field during the period when bees are actively pollinating the blossoms. Under these conditions, state recommendations usually specify the application of toxaphene late in the evening or early in the morning when bees are not in the field. Toxaphene on the plants apparently repels the bees so that they stay out of the field until the insecticide has lost its toxicity to them. In this way the destructive insects are controlled without removal of the beneficial insects necessary for alfalfa seed production. (4) Emphasize to the customer the need to respect "waiting periods" before grazing or harvesting. These waiting periods have been worked out by the U. S. Food and Drug Administration to avoid undesirable residues on the plants which might result in residues in the meat or milk of animals. (5) Store pesticides in separate dry storage. The preservation of a legible label on every pesticide container is extremely important. Pesticide containers stored outside or in inadequate storage may lose their labels completely. If you don't know what the pesticide is or how it should be used, you have a potentially dangerous material. Commonsense dictates that such containers should be destroyed. In these cases, the money invested would be lost. If unlabelled pesticides are used, the operator runs the risk of killing livestock or crops. The only safe procedure is to store pesticides properly.

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RELATION OF SEED TESTING TO WEED CONTROL

Charles Ver Straeten[1]

Too much stress cannot be laid on the economy of having clean seed for all crops, even if what seems to be a high price has to be paid for it. There is no such thing as bargain seeds until the purity, germination and the weed seeds are figured on both high quality and the so-called bargains. The number of seeds per acre needed for a good stand and how many weed seeds will grow from a weedy lot of seed.

Crop seeds are judged by both pure seeds and germinated seeds, weed seeds only by purity tests.

Information concerning dormancy and longevity of germination of weed seeds has been hampered by the scarcity of information on methods of testing weed seeds. This is important because dormancy is much more frequent and persistent in weed seeds than in those of cultivated crops.

Weed seeds are not natural to the soil. They are very harmful in crowding out plants, robbing the soil of food and water and causing loss of quality of crops. Extra work preparing the land and extra cultivation is needed. Many weeds are unsightly on the farm.

Part of the spread of weeds to new localities is due to being spread by seed of poor quality. Our state seed law allows 1½% weed seeds. Very few samples of clean seeds have 1½% weed seeds present, some southern brome. We receive a number of farm samples that are in excess of 1½% weed seeds.

Weed seeds were growing in our central USA long before the white men settled. Indians were the first to cultivate the land. Still a large per cent of our weed seeds comes from foreign lands.

The Weed Commissioners and anyone that has visited a modern seed cleaning plant know that almost every weed seed can be removed from a lot of seed. Sometimes it is not profit wise as the shrinkage would be too large. This seed is bulked in clean seed and that will bring the number of noxious weeds per ounce to leave very few per acre. This method is not approved by us. This makes it a wise farmer that buys his seed from where the seed has had a chance to be expertly cleaned. There is no one machine that will remove all kinds of seeds. Some light seeds are removed by wind, some by shape because they are round. Others because they have a mucous for steel dust require still another process. Some of these processes are slow. The seed analyst must know what weed seeds are present so they will know what process to use to eliminate this weed seed.

All the testing of seeds in the State Laboratory is by methods set by the Association of Official Seed Analysts. The members of the Association are all official laboratories of the Federal, State and Canada governments. All standards are set up by experimental work and approved by the Association.

In the germination test all seeds that have germinated are in two classes: normal seedlings and abnormal seedlings. A normal seedling will develop a strong root and stem that will grow in soil. An abnormal may be stubby, malformed and weak. A seedling is a young plant that is still dependent on the seed for its food. Dormancy is of 3 types:

A. Seed impervious to water.
B. Seeds in which the embryo is not fully developed.
C. Seeds having coats pervious to water, but impervious to oxygen. Secondary dormancy may be induced by high temperatures in freshly harvested seed.

All freshly harvested cereal and grass seeds are chilled before testing to break dormancy. The only sure method of getting dormant seed to germinate is by mother nature.

It takes patience and practice to recognize at sight the weed seeds grown from around the world. We test imported seed every year that is offered for sale in

Iowa. A large per cent of our seeds are grown in the north and west of the United States and Canada.

We have pictures and descriptions of many of the seeds, plus samples of most every kind of seed which we have found in seed tested in the laboratory. We identify most of the seed with the magnifying glass. We use hand lens and microscope for difficult seeds.

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COMMON COMPLAINTS AS THEY RELATE TO CUSTOM AND FARM APPLICATORS IN THE CONTROL OF BRUSH AND WEEDS

Charles L. Laverty[1]

(No abstract received)

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CANADA THISTLE CONTROL

R. S. Dunham[1]

Several of my colleagues helped in the preparation of this paper. At my request Dr. George Friesen and Prof. D. A. Brown from Canada, Dr. Earl Helgeson from North Dakota, Dr. Lyle Derscheid from South Dakota, Dr. Ken Buchholtz from Wisconsin, Dr. Bruce Rogers and Dr. Oliver Lee from Indiana, and Dr. C. J. Willard and Dr. D. D. Bondarenko from Ohio sent me their recommendations for Canada thistle control. Gratefully, I wish to acknowledge their generous assistance. I asked for this help, first, because I needed the best thinking on the subject from several sources and, just as importantly, because control methods vary in different areas.

The prevention of seed production by Canada thistles and the knock-down of its top growth, even selectively, is relatively successful with 2,4-D, MCP, the butyrics, and, in some instances, the dinitros. The problem is to kill buds on the lateral roots that are capable of regeneration. The first slide shows the deep creeping root system. New shoots arise along these horizontal roots. A kill depends on (1) exhausting the food reserves through continued cutting of the shoots, (2) depleting food reserves and killing of buds on lateral roots by chemicals, and (3) penetration through the soil of soil sterilants. Various methods of tillage, cropping, spraying with chemicals, and combinations of these methods are used.

Table 1. Treatments of thistles fall plowed

Spring	July 1	Fall
1. Cultivate every 3-4 weeks until freeze-up		
2. Cultivate every 3-4 weeks	Sow crop*	Cultivate
3. Cultivate every 3-4 weeks		Sow crop**
4. Cultivate every 3-4 weeks		Sow alfalfa

*Sorgo, Sudan, or proso millet **Winter wheat or rye

Second year

1. Repeat on heavy soils.
2. Repeat or sow oats and spray twice.
3. Plow after harvest and cultivate. Fallow next year.
4. Cut for hay 5-6 years.

Cultivating every 3-4 weeks during the entire season, the first treatment in Table 1, is very effective but costly and conducive to erosion. On the lighter soils, eradication may be accomplished in one year; on heavier soils, a second year of fallow is required. In treatment No. 2, spring cultivation weakens the thistles so that a late-sown crop may compete very successfully. Sorgo, sudangrass, or proso millet have usually been best adapted in the northern part of the area; close-drilled soybeans, hemp, or buckwheat farther south. Cultivation should follow harvest and the treatment repeated the second year or oats should be sown and the thistles sprayed twice; once in the crop and again after harvest. Treatment No. 3 employs winter wheat or winter rye which are sown following a summer fallow. The land is plowed after harvest the next year and the treatment repeated or the field fallowed the third year. Alfalfa is used widely and successfully to smother thistles. Cultivation preceding the sowing of alfalfa is necessary where thistle stands are thick. If the alfalfa is sown with a companion crop, it is advisable to mow this crop before the thistles bloom.

Table 2. Thistles sprayed in oats June 5*

Treatment after harvest	Per cent kill
None	31.8
Sprayed 8/25	79.4
Plowed 8/15, sprayed 9/15	88.1
Plowed 8/15, sprayed 9/15, cultivated 10/25	83.4
Plowed 8/15, cultivated 9/8	87.6

*¾ lb. 2,4-D amine

Repeat treatments second year

Crop	June	August	September	October	Per cent
Corn*	sprayed				165 increase
Corn	sprayed		sprayed		38 decrease
Corn	sprayed		cut for silage	plowed	1 decrease
Oats	sprayed	sprayed		plowed	100 decrease
Oats	sprayed	plowed		cultivated twice	100 decrease
Oats	sprayed	plowed and cultivated twice		cultivated once	100 decrease

*Cultivated 3 times

The data in Table 2 are the averages of 2 years of trials at the Agricultural Experiment Station of the South Dakota State College. The thistles were sprayed in oats, June 5, and variable treatments made after harvest of the crop. The poorest kill followed spraying only once, better kills resulted from two applications, and best results followed three sprayings or two sprayings plus cultivation.

To eradicate the thistles, treatments were made the second year on the stands remaining from the first year. The plots were cropped partly to corn and partly to oats. Results were not too encouraging in the corn but complete eradication was accomplished on the oats plots. Dr. Buchholtz recommends that thistles be allowed to come up in corn after planting, that cultivation be eliminated or reduced to a type that does not cut off the thistle shoots, and that the thistles be sprayed with 2,4-D after a full stand has emerged. If the corn is harvested for silage, a second spraying can be made in the fall.

Table 3. Thistles in small grain sprayed* pre-bud

Treatment after harvest

1. Cultivate from harvest to freeze-up.
2. Plow and spray later.
3. Spray and plow later.
4. Spray when thistles bolt and 8 days later (in bud).

*2,4-D or MCPA

The first three methods in Table 3 are recommended generally throughout the north central area. MCPA is preferred to 2,4-D in Manitoba and is quite generally recommended for oats and for small grain undersown with a legume. Several states prefer the ester formulation of 2,4-D to the amine for wheat, barley, or rye, but do not recommend it for oats or corn. In Minnesota, we prefer treatment No. 2 to No. 3 since weeds not killed by 2,4-D are kept from producing seed by plowing immediately after harvest. The rate of application to the small grain is determined by the tolerance of the crop. The last treatment in Table 3 is recommended in

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Manitoba to kill top growth of thistles in wheat or barley. Six ounces of 2,4-D, ester, are used for each treatment.

Table 4. ATA for thistles

Pre-treatment	Time of application	Rate lb/A act. ingr.	Post-treatment
1. None	Spring. Thistles 12" to closed bud	4	None
2. None	Thistles in bud	5-8	Leave undisturbed for 1 month and cultivate
3. Mow thistles when mature in grain stubble in meadow plowed in June	Late summer or early fall when regrowth is 6" to bud	4	None
4. Spray thistles before planting corn or soybeans	Thistles 6" to 8" tall	4	Leave undisturbed for 2 weeks before making seedbed

Volume: with boom sprayer, use 30 gal/A; with spray gun, 100 gal/A; with knapsack, 1 oz/gal/sq rod.

Amino triazole (ATA) is a newer chemical that has been found more effective for eradication of Canada thistle than 2,4-D or MCPA. Early application has not been successful, especially if the thistles have recently been plowed. Dr. Buchholtz points out the necessity of having a maximum stand of shoots at the time of treatment. He believes that best results occur on areas that have not been plowed the year before treatment, poorer results occur after fall plowing, and poorest results follow treatment after spring plowing. He recommends mowing thistles after spring plowing followed later by a spraying of the regrowth.

In Table 4, the second treatment is suggested by Professor Brown. Larger amounts of ATA have been required than in the U.S. He has found that adding 2 to 4 lb/A of 2,4-D ester increases the effectiveness of the triazole and that cultivation helps, providing it is delayed a month after treatment. Ohio, Indiana, and Wisconsin emphasize the mowing of thistles before treating under the conditions listed in treatment No. 3. Poor results can be expected if plants are in full bloom or mature when sprayed. They should be cut and the regrowth treated. The clipping of wheat or oats stubble immediately after combine harvest and the removal of straw is a standard practice in Ohio. It is done to save the legume seeding. Thistles that have made at least 6 in. of growth can then be sprayed effectively. Likewise thistle regrowth following the first cutting of a meadow or regrowth on areas of thistle plowed in June has been sprayed effectively in Ohio.

Since ATA disappears rapidly from the soil, treatment No. 4 is practicable. Although the table indicates that the thistles should remain undisturbed for two weeks after treatment, Dr. Willard and Dr. Bondarenko believe it is more important to have a maximum emergence of shoots before treatment than to wait a long time after treatment before plowing or disking.

With the exception of lay-by applications in corn and pre-planting treatments for corn and soybeans, ATA is used non-selectively. Soil sterilants such as sodium chlorate, borate, and various mixtures of borate with chlorate, 2,4-D, and urea can be used effectively but they remain in the soil for at least one season and are generally more costly than ATA. There are two newer chemicals, 2,4-DB and Simazin, that have shown promise in Europe for selective thistle control and should be evaluated thoroughly in this country.

In conclusion, many studies of Canada thistle control have shown unpredictable results not only with chemicals but also where cultural methods have been used. Unquestionably there are many factors involved that are only partially recognized or understood. With chemicals, there is the probability of resistant strains of thistle. Reports from farmers and other observers indicate that there are Canada thistle types that are more resistant to 2,4-D than others.

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YOUR STAKE IN WEED CONTROL

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(No abstract received)

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WEED CONTROL IN CORN AND SOYBEANS

D. W. Staniforth[1]

(No abstract received)

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YOUR JOB IN WEED CONTROL

A. L. Bakke[1]

This is the Fourteenth Annual Meeting of the North Central Weed Control Conference. In 1946, the time of the last Des Moines meeting, 2,4-D had been given only preliminary hearings, and showed that we had a new ally in weed control, in fact, one of the important building stones in modern agriculture. Our organization has been unique throughout, built around the farmer, the regulatory worker, the manufacturer, the extension worker and the scientist. Perhaps there is no organization where there is more cooperation than exists between these groups.

Our whole population is dependent upon plants. The control of unwanted plants, weeds, is a public problem —it is our responsibility. The yearly damage due to weeds in the United States is five billion dollars. In Iowa the average cost per farm may be set at $500 a farm. The person in control of any land or property must take the primary responsibility for the control of weeds. If all of us were good stewards of our land there would be no need for regulatory work.

My introduction to the weed problem came early. At that time the hoe and pull method were the tools at hand. If a plant was cut off at the base often enough, it would die. These methods were not sufficient; even the good farmers did not like to hoe and pull any more than I. With the usual number of *laissez faire* farmers, weeds, particularly the perennials, became a problem. Canada thistle, sowthistle, and European bindweed got a firm foothold.

It is the function of research to ferret out information which will help solve the problems at hand. In the case of the Agricultural Experiment Station, your problems become our problems. Let me give you an example.

In 1930 the County Extension Directors of Northwest Iowa met to discuss their problems. They came to the conclusion that the weed problem, European bindweed, was at the top of the list. They petitioned the Director of the Experiment Station for help and for experimental work on the control of weeds. Since the Department of Botany had been associated with weed work under Dr. Pammel, this department was given the job. Mr. Walter Scott was the owner of a farm near Hawarden which had plenty of bindweed and leafy spurge. Here we established a field laboratory. Mr. Sherman French of Hawarden contributed a hexagonal hog house and this became our headquarters. Here a good many fundamental principles were discovered. In 1936 we moved to the State Hospital at Cherokee where the facilities were better; at the same time here were more than 80 acres of bindweed. We spent much time investigating the root system and found that many times the main root of bindweed was 15 feet or more in

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depth. In our excavations we found that at a depth of about five feet there was no aerial growth. Measuring the light intensity, there were only 32 foot candles. This measurement told us that light was important. If we could grow a smother crop on the infested ground and reduce the light intensity sufficiently we could control growth of the bindweed. By plowing the ground and drilling in soybeans we had a method for control and at the same time had a crop.

It is interesting to note that one problem meets another, sometimes far removed. The soybeans competed with the bindweed. They produced a starvation stage for the bindweed. The roots were reduced in number but the ratio of the different forms of carbohydrates remained the same throughout, until the very end. This gave us the reason for bindweed's survival.

The method of keeping the ground fallow has been one that has been used. It took us three years to clean up an area. We did find that cultivation once every 10 days was as effective as cultivation once or twice a week.

With the advent of 2,4-D, we got a new weed control tool. This largely replaced sodium chlorate. Mustard and other broad-leaved weeds were killed by this chemical, in most cases at less than ½ pound per acre. Most of the flax growers now spray with 2,4-D or MCP at the rate of about ¼ pound per acre.

I mentioned earlier that one research problem meets with another. While cutting up root samples of bindweed for chemical analysis I clipped the end of my index finger and noticed that it did not bleed. On testing further we found that the material had blood-clotting properties. Bleeding from cuts was reduced 50 per cent. In this root material we found that chicks thrived on the ground material. However, if the root material was heated, 50 per cent of the chicks died within a month's time. Boysen-Jensen of the University of Copenhagen little realized that in cutting off the tips of the oats plant he was setting the principles for weed control. Much more fundamental work needs to be done. We should know more about the plant itself. Much work has been done with various herbicides. Certain plants are more resistant than others, and again many plants are more resistant to certain chemicals at certain stages in their life history. Corn during the early stages of growth is tolerant of 2,4-D but later the stalks bend and become turgid to the point where they break easily. Certain new compounds like Randox, Simazin, and others can be added to the soil after planting. TCA sodium salt at 5 pounds to the acre will not affect the development of the flax plant or sugar beets. It appears as if the time will come when it may be necessary to have a specific herbicide for a specific crop or weed.

It is the function of industrial organizations to develop and screen chemicals which appear useful for the control of weeds. I must say that our chemical concerns have presented new chemicals usually better than what we have had before. These new chemicals should undergo a reasonable period of testing, so that they can be sold on their own merits.

It is the function of the Extension Service to bring the latest findings in industrial and research technology to every person interested in weed control. Extension must leave no stones unturned to give every one an opportunity to get his own specific questions answered and to bring to the general public the current findings of cultural and herbicidal technology.

It is the function of the Regulatory group to corral the non-comformists and the people who are non-cooperators in the realm of weed control. Unfortunately noxious and other bad weeds do not stop at fence lines. One poor cooperator in the struggle against weeds can bring to naught the efforts of many conscientious operators. Stricter regulations must be made. The will of the majority must be the aim of all regulatory workers in the realm of weed control, the same as it is in the control of health, highway and tax laws. It is the function of the State Department of Agriculture to see that every single county undertakes a good aggressive conscientious weed control program. Weeds do not stop at county lines. A state-wide weed control program to be effective must be uniform throughout the length and breadth of the state.

It is the function of the County Board of Supervisors to undertake a good constructive weed control program at the county level. The roads should be such as can be easily sprayed or mowed. A good enlightened board of supervisors should be far-sighted enough to hire a good weed commissioner who spends full time in educational and regulatory work. He might develop a five or ten year plan for the control of weeds looking forward to a complete eradication of such weeds as Canada thistle. The regulatory notices must be sent out in plenty of time so that the one who never responds except under pressure can get the job done of his own volition. Then if it becomes necessary for the weed commissioner to go to the property owner, the legal procedures should be followed with firm unbiased actions. The city or town dweller is in the same category as far as weed control is concerned.

Every single group represented here today has a responsibility in the field of weed control. During the ten year period since the North Central Weed Control Conference met here there has been a marked improvement; people generally have become more weed conscious. The manufacturer has developed more and better herbicides, the research man has secured additional information about plants and conditions necessary for weed eradication, and the regulatory and extension men are showing the way. It is now up to you.

[1] Iowa State College, Ames, Iowa.

HOW WE CAN HELP IN WEED CONTROL

Herb Plambeck

My interest in weed control dates back more years than I like to remember.

About 40 years ago, my father discovered a patch of Canada thistle on the back 40 of our farm in Scott County, Iowa. Somewhere along the line he had heard that the way to kill Canada thistles was to cut them off and then put salt on the plant where it had been cut off at or below ground level. He also heard that frequent spading up or plowing of the thistles, exposing their roots to the sun, would also eventually annihilate them. It seems to me the plow was always busy plowing up some other field for corn or wheat, which left most of the eradicating to be done by means of young Herb and his spade. I feel, therefore, that I can truthfully say that I have learned something about weed control the hard way.

Later on, I became old enough to become a 4-H member, and we had a leader who was interested in weed eradication and weed identification work. Our family wasn't well-to-do enough to permit me to go into such projects as baby beeves and the like, but we could afford some free bulletins dealing with noxious weeds, and these I put to good use in the weed identifying project. Later, Professor J. C. Cunningham, that grand old Prof. at Iowa State College, had charge of a 4-H camp at our fair where, among other things, he directed a weed identifying contest. Believe it or not, I won that contest and received a trip to the Boys Short Course at Ames which was my opener to this wide, wide world in which we now travel. Therefore, I feel I'm justified in saying that my interest in weed work has meant a lot to me in the years that have followed.

Perhaps at this point I should make one other confession. Flush with my victory at the Davenport fair, I thought there must be more worlds to conquer.

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Accordingly, I suggested to Wallace's Farmer and Iowa Homestead that there ought to be a weed identifying contest at the State Fair. They agreed, and put up $3 for the top state award. Three dollars at that time looked like $30 does to me now, so I did some more "boning up" and ungrateful as it may seem, I went in and won that first prize. Weed interest, therefore, has paid off to me in more ways than one.

My assignment here is to suggest to you how we in radio, TV, newspaper, magazine and in other fields of communication can help in the challenge of weed control.

In my opinion, there are many ways in which we can help. Moreover, I believe most of you will agree that those of us in the communications field have already been of some service in this regard. Unquestionably there is much more yet to be done. "Dutch" Sylwester in his invitation to me, indicated he would like to have me also incorporate Extension Service, Weed Commissioners and other groups in my general thinking. In fact, because this is Farmers' Day here at the conference, he suggested that my remarks be directed primarily from the standpoint of what farmers and regulatory workers might like to have us do in helping in this crusade.

Unfortunately, I am not a farmer so I can't speak for them even though I know there are many folks like me who farm the farmers, and who profess to speak for them. I have, however, tried to get the opinions of a number of farmers as well as of extension workers, newspaper and magazine people, radio-TV people and others and in this presentation I would like to pass on to you some of the suggestions provided to me.

Before getting into specifics, let me say to all of you whether you're a farmer, weed commissioner, other regulatory worker, spray company representative, college man, soil conservationist, botanist, horticulturist, biologist, seed analyst, pathologist, extension worker or what have you, and whether you are from the U. S., Canada or anywhere else, I think I can assure you that most of us in the field of communications, are more than ready to help you in whatever way we can.

You must remember, however, we are not experts, nor do we want to be, in weed control work or any other given field . . . especially not with the definition of expert as now given, wherein it's pointed out that ex means former, and spurt means a small drip under pressure.

We must count on you people to tell us how we can be of service, and when we can do the story, make the report, conduct the interview, take the picture, etc. This I am sure you will find us more than ready to do if you'll give us the opportunity.

Now for the suggestions. You will find many of the suggestions apply to all media.

Al Bull, Managing Editor for Wallace's Farmer, says "Farm papers can and should:

1. "Carry stories on chemicals and practices useful in controlling weeds. Also emphasize **how to** use chemicals since careless use can be dangerous and make chemicals less effective.
2. "Call attention to the need for weed control. This is sometimes neglected on the farm.
3. "Keep in contact with specialists who know the latest recommendations. We welcome suggestions from both specialists and farmers on what information they think is needed.
4. "Report experiences of farmers who have used chemicals successfully. This should encourage others.
5. "Point out areas where additional work is needed. Keep people aware that each county has a Weed Commissioner and that he is charged with definite responsibilities."

Wallace's Farmer and similar magazines have been in the forefront in the battle against weeds, and in helping to prevent weeds from getting the upper hand in the future. Of course, this has not been limited to their editorial pages. All farm magazines are not above taking some advertising money from the spray services and chemical people and neither are the newspapers, and neither is radio or television, but certainly we'll all agree that this is all a part of the over-all effort to control weeds. A self-help program that helps all of us that are involved.

Newspapers and farm Sunday supplements, etc., also help materially to convey timely information on weed control and to speed up effective work in this field.

J. S. Russell, editor of the Iowa Farm & Home Register and farm editor for the Register & Tribune, says:

"Reporting of new developments from the experiment stations, reporting of the recommendations of the Extension Service, telling of newest materials being offered by commercial firms all contribute to effective weed control.

"These are being done, and can be done, by all farm magazines and newspapers.

"The reporting of meetings like this one is a factor in such programs.

"The telling of what is being done in itself is a step in the right direction of weed control as are reports of meetings of weed commissioners and of groups where weed control is discussed.

"The speedy adoption of 2,4-D and other chemical weed controls can be attributed to widespread publicity in which the newspapers with farm coverage made a contribution, along with other media.

"Still another factor has been the printing of experience stories with pictures indicating how farmers have made use of the information available to them through research by public and private agencies. Reports on demonstrations and test plots can be helpful too, and have proven so here in Iowa."

It should be said that the Iowa Farm & Home Register magazine and the farm pages of the Sunday and Daily Register, like many other progressive newspapers who seek to serve agriculture, have helped materially in waging Iowa's war on weeds. Several years ago and for several consecutive years, the Iowa Farm & Home Register worked with the State College and commercial firms in sponsoring a series of clinics on weed control and corn borer control. This was at a time when chemical controls were relatively new so the effort had the benefit of "newness" as well as newsworthiness. Undoubtedly, the magazine and paper benefited through sales of advertising to chemical and spray firms but without question, many readers, unable to come to the field days themselves, also benefited in their individual weed control efforts.

Radio and TV people can likewise be of great service to you if you will give them a chance.

Radio and TV probably cannot provide the detail, and it would be difficult to try to establish specific or involved instructions in this manner, but our medium certainly can be of real value when it comes to seasonal references, or if a sense of urgency develops. Radio and TV as you know have the advantage of being able to provide information almost instantaneously. We also have the benefit of repetition because of the number of programs that most of us do daily in this field.

Like our friends in the press, we can do much to call attention to the need for weed control. In some respects perhaps we can do it a little more emphatically or dramatically than they can. Certainly we can also help out when it comes to the announcing of meetings and the drumming up of interest for and at those meetings. And, like our colleagues in newspapers and magazines, we can cite success stories and similar information that may be of value in the war against weeds.

We have still another advantage to offer. We can put the weed control expert on the air or on television, as we often have at WHO, and let him do that effective "person to person" type of presentation which makes the farmer or gardener or lawn fancier think that the specialist is speaking directly to him.

Many radio stations also have a part in conducting

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field days. Some of you are aware that WHO has been active in this manner. Through our state and national soil conservation field days, we've been able to help tell the weed control story. Hundreds of thousands of people have been attracted to these events, and in addition many thousands of others have heard the broadcasts.

May I say for all of us in radio and TV work, we stand ready to help you, if you try to avail yourself of our services.

As for the Extension Service, in the last analysis undoubtedly the County Extension Directors and the Dutch Sylwesters and others who are highly placed in the state Extension Services, have made an even greater contribution than anyone else. I've talked with a goodly number of County Extension Directors as well as with Marvin Anderson at the head of this work at Ames, Bob Pinches, the state 4-H leader, and Dutch of course, and I am convinced that if any medals are to be handed out in the weed control effort it would need to go to people like that.

However, I have gained the impression from those with whom I visited that they feel one of their great values in the over-all effort is to provide information to the press and radio in their own states. They believe that the mass media approach in weed control is a very effective one. Others may disagree, but certainly the mass media can help wherever there is a desire to be helped.

Certainly also we know that weeds are a continuing problem, and we have to continuously bring new and more effective measures to the attention of the people who must put those measures into use. Those of us in press and radio can help do that job. The magazines and newspapers can give you the long and detailed information, the radio and TV can give you the benefit of instantaneous information along with some of the major details.

County Extension Directors with whom I talked just this week said that major questions they are asked include:

Calibrating the spray machine.
Standardizing the strength of 2,4-D and so forth.
Identification of poisonous weeds.
Timing of the control measures.
The place that the Weed Commissioner has in the picture.
The meaning of brand names.
The significance of the various active ingredients.
The part that tillage can play.

Extension people, particularly County Extension Directors and County Youth Assistants, do a lot to conduct meetings on the weed control topic.

I am sure we can help them to publicize those meetings as well as to help them answer the questions that I have just listed.

I suppose this is a case like so many others I can think of where we're talking about things we're trying to do for the farmer, without consulting the farmer.

I am sure I've not talked with enough farmers on this matter, but I have talked to some. One of those with whom this was discussed was Clarence Long of near Shannon City who tells me he was the runner-up in that state weed identification contest of those many years ago. Fact is, I hadn't seen him for right at 20 years until this summer and when he introduced himself we immediately dealt with the question of weed control and he told me that he is not only employing weed control practices on his own farm, but that he is now leader of a 4-H group and has made weed control, and weed identification, one of his club's projects. He says the boys like it and he feels it will be of great value to them in the future just as the work he did as a boy has been of great value to him now as a farmer.

Other farmers here have told me that they get considerable of their information from the press, radio and TV . . . especially in terms of general information in which they are interested, but they also add that when it comes to specific questions they need to go to their Extension Directors, Vocational Ag men, and to their commercial people. This again points up to me the importance of the press and radio being provided with information we can help disseminate.

Now if I may interject a couple of thoughts or suggestions of my own, in addition to what I've previously said about radio and TV opportunities.

I have the feeling we haven't done too good a job of dramatizing weed control work. By we, I'm speaking of all of us . . . you out there on the firing line, and those of us who tell about the battle you are waging.

It seems to me this general subject has a multitude of possibilities in dramatization, or in focusing the general public's attention on the over-all challenge facing us. Certainly, we all know that ragweeds are a pretty unpopular plant come hay fever season, but time and again the hay fever sufferers pay virtually no attention to ragweed plants until the day they start sneezing. In fact, I know some sneezers who literally produce their own hay fever in their own gardens and back yards. I think that's one place where we can do a little dramatizing.

Primarily, weed control work is an educational effort rather than a stage production, but even so, I am sure that we could help to focus a brighter spotlight on control work.

For instance. down at the Iowa State Penitentiary, Warden Percy Lainson is personally very interested in weed control work and so are some of those men behind the walls. For three years, Lainson has tried to persuade us to do something in spotlighting weed control work. He says some of his inmates have been doing excellent work in the parks as well as on the prison farms. He adds that some of those same men have suggested a weed control week or a weed control day on which emphasis would be placed emphatically on this general theme. He adds of course, it's his feeling that interests of this nature help in the rehabilitation of men behind the walls.

Personally, I am inclined to go along with Warden Lainson on his proposal. That's partly because I'm in show business and I have had considerable experience in dramatizing better land use, soil conservation, plowing matches etc. I thing the Register & Tribune people were working toward that end with their emphasis on this topic several years ago. I'm sure we're safe in saying that there has certainly not been any highlight date or period for such a project. I would guess that the commercial people would go along on this kind of a program.

I realize however that it takes a lot more than a prison inmate, a couple of radio guys and some commercial firms to make a success of an observance of this nature. I am quite aware that the North Central Weed Control conference has had a committee study the feasibility of a National Weed Control Week, and that the committee has felt reluctant to recommend it, partly because there already are about 200 weeks assigned in the year from "eat more horse-radish" week to "change more baby diapers" week, on up to such worthwhile things as national farm safety week, national farm-city week, fire prevention week, soil conservation week, etc.

I know that another reason why the North Central conference has voted against emphasis during a specific week is because weed control is a 52-week of the year proposition, or at least it is a program that needs to be emphasized throughout the growing and harvest seasons. In answer to that however, I would say to you that fire prevention should also be a 52 weeks of the year proposition, and so should farm-city week, and maybe change more baby diapers week ought to be a year round proposition too.

I am not going to assume the herculean task of starting an Iowa or National or a North-Central Weed Control week. I've had about all of that in National Field Days with Presidents Eisenhower and Truman, and would-be presidents Stevenson, etc. on my hands. But, I feel that if such a program had any merit, we people

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in radio, TV, newspaper and magazines would sure give it some emphatic boosts.

Dutch Sylwester and some others with whom I talked feel that a more worthwhile project would be to arrange for some honoring or rewarding of groups or individuals, outstanding in weed control. I could go for that in a great big way because those of us in communications could certainly enter into that picture with a minimum of work and extra obligation. Such people might even be recognized at a meeting of this nature.

I also would like to incorporate a salute to those Extension people, Vo-Ag leaders, and others who have done specific work on weed control in their own province. For instance, in Pottawattamie County they've had some 4-H projects in which weed collections have been made by the youngsters where weed identification has been a specific project and where the "weed of the week" has been publicized in the press and by the radio. This program was even carried to the State Fair where the winning Pottawattamie youngster's exhibit was on display at the 4-H building. I understand from Bob Pinches, the state 4-H leader, that these types of programs can be conducted as special activities in any county. I understand there will be more of it this year. Surely it will help sharpen up the youngsters and their folks on plant identification and on recognizing noxious weeds. Moreover, with the renewed concern about the Sputniks, and the renewed interest in basic science, this sort of thing ties in with school classroom work. What's more, 4-H youngsters in town and urban areas as well as those on farms can get into this act. And on top of all this, I am quite positive we can look to the commercial people to be of help in this regard, in offering prizes to winners and more importantly, in sending specialists out to meetings where weed identification and control could be stressed. This would certainly help to answer the program chairman's question for at least one meeting of the year, too.

I don't know whether to call this dramatic or call it morbid, but many of you know that country cemeteries are often sadly neglected and badly over-grown with weeds. I wonder if we can't do a little more in demonstrating weed control and its effectiveness in special places of interest such as the country cemeteries, church yards, school yards, etc.

W. B. Rittenhouse of near Keota, Iowa wrote me this summer suggesting that our forefathers and our soldiers who have been put to rest in the cemetery desire more reverence and respect than the neglected condition of country cemeteries often indicates. The Iowa Grange has done a good job in this respect, but the Grange is not located in enough areas to do the total job.

May I suggest another project which certainly is not original because I have alluded to it twice before. With all the interest that is now so obvious in weed control, and with the deplorable lack of recognition of noxious and poisonous weeds on the part of so many of the people, in rural as well as urban areas today, isn't there a place for a revival of the weed identification competition at the State Fair or at some other significant state-wide function?

The possibilities of such a program could be endless. We could start on the county level and carry on through the district, then on up into the state. It could easily go national. It could be a project that might be undertaken by the state 4-H people or the state FFA people, or by the State Fair. If none of these groups deem it of sufficient interest, it might be something that the commercial people could agree upon. Or perhaps the North Central Weed Conference could consider this as a highlight feature. I would think that prizes or other rewards would not be too hard to arrange.

In my opinion, this would not be a difficult or terribly time-consuming project. One good specialist like Dutch Sylwester could probably accumulate 25 or so live specimens of familiar weeds, lay them out on a table ready for the competitors and with a little help conduct the contest in a matter of a couple of hours time, or less.

May I close by reminding you again that you can be assured that the newspapers, magazines, TV stations and radio stations all stand ready to help in your battle against weeds. We believe we can be of assistance to the extension people, commercial people, weed supervisors, weed commissioners and everyone else who might benefit from our help.

After hearing the Canadian speaker and others yesterday tell about the reduction in yields, and the other losses to weeds we want to help more than ever. However, all the printer's ink in the world won't poison the plants nor will the air waves or even Sputnik itself eradicate the weed pest. In the last analysis, it's education, and you, who must do that job. But I say again I am sure that we can help.

[1] Farm Director WHO-TV, Des Moines, Iowa.

GETTING THE JOB DONE IN WEED CONTROL

Dwight Lambert[1]

The job of getting weed control under way is a large one without thinking about getting it done. "Weed control is a job for neighbors but not for me, he has the cockleburs or bindweed." This is one attitude which you must conquer before you can get the job done. Another is, "Well, that patch has been there for ten years and it has never gotten any larger." Weed patches have a way of not getting any larger to the eye, but once they are measured then they really expand.

There are many ways to keep from doing the job in weed control, not only by the farmer but also by the organized weed personnel, whether they be supervisors, commissioners, managers, etc. I have seen them and I know you have. One of the best ways not to get the job done is to have such a disorganized program that no one can possibly tell what you are doing. Yes, there are some like that. Another, is to hire a man who has no experience in weed control and turn him loose with spraying equipment without any prior knowledge of how the equipment is operated or how to use the chemicals.

The title of the talk was "Getting the Job Done in Weed Control", so perhaps we should spend some time on that. You know it is easier to play hooky than get a job done and that is what I have been doing.

To get the job done in weed control, I suggest we divide the subject into four parts. The first one, is a weed survey. You must know where you started, if you want to find out how far you have traveled. This is one of the most important jobs in weed control. In making a weed survey of your town, precinct, or county, you not only find out what kind of weeds you have and how many, but in addition can become well acquainted with the people in the area and find out their problems and also some of their solutions. A survey is worth the money, in fact, it is more than worth the money to the man in charge of weed work. A survey must be kept up to date to be of maximum value not only to you but to the community.

The second part of getting the job done as I have chosen it, is education. This can assume many forms and not only applies to educating the farmer but also the weed men. Types of educational projects I have in mind are: First, individual farmer conference. This could be combined with the survey or handled separately. It should consist of planning for weed control, not only for next week, but all year and for years ahead. Weed control should be part of the crop rotation and will be a plan for before it happens rather than after

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you have it. "Why lock the barn after the horse is stolen" and in weed control, this certainly applies.

The second type of educational project which can help stimulate interest is group meetings. At these you can show slides of weed control or perhaps spend the evening identifying weeds. This would be on a local level and quite a bit of personal work could be done with the personnel attending. Always try to keep the program at a meeting of this kind on an even keel. Do not point accusing fingers at any one individual and try to keep others in attendance from doing it. Remember this a meeting you arranged to show or tell them all something about weed control. Plan it that way and conduct it that way.

Other methods of educational work which can be used and should be mentioned are traveling exhibits, weed tours, demonstrational weed plots, news releases by all media available, and bulletins. I am sure there are more but this will bring out a few.

To continue the subject of getting the job done, there is an old saying, "that an ounce of prevention is worth a pound of cure." In explaining this I would say, "Why plant weed seed?" It is much easier and cheaper to eradicate weeds by not planting infested seed than by trying to control the weeds once they are in the ground. To do this, to improve the quality of seed that is planted, a third suggestion is, an inspection service which is available and would be a great benefit both to the seed dealer and the farmer. This would give assurance to personnel who buy seed that the seed which they receive is free of weed seed. It would also encourage the farmer to have seed which he raised or bought over the back fence from his neighbor checked before planting it. During the past two years with money being tight on the farm, it has been quite a temptation for farmers to buy the cheapest seed available, money wise, that is. In most cases that I have checked, this has been just the opposite. The cheapest seed has proved to be the most expensive. To explain this, I will say you usually get a low germinating, low purity seed along with all the weed seed the law will allow, plus in some instances more, and in many cases, noxious weed seed in addition. Sure there are laws to punish the offender but that will not take the weed seed out of the ground.

My fourth suggestion to get the job done is strict compliance with existing weed laws. By this, I mean if every other approach to a situation fails, then resort to enforcement. Weed workers in administrative positions must remember that the offender in most cases causes or at least is a possible cause for weed problems for his neighbors, who are farmers trying to do a good job of weed control. By letting an offender go you are inadvertently causing serious trouble for many good farmers. It is much better public relations wise as well as being practical to have one farmer mad at you in a community than to have all but one mad at you. Especially since he probably will not stay mad once he sees what can be done with weed control methods. There are many things which enter into law enforcement; i.e., the approach you make to the offender and the problem that he has, the approach and help you get from his neighbors. All these must be taken into consideration.

I have now covered four ways which can be used in getting the job done in weed control. I am sure there are more, however, none of these will be of any consequence if the man or men responsible for seeing that the job is done, do not follow them. Weed control in any given area whether it be on a farm or at the county or state level is a full time job. Persons in this type of work must live, eat, and sleep weed control. There can be no slack periods. With snow on the ground, plans should be formulated for the coming season. During the growing season, work must be done to control and eradicate weeds so that the problem will become smaller not larger the next year.

Weeds have been with us since Biblical days and will continue to plague us. With the changes in agriculture which we have now and will continue to have, we cannot afford to let go to weeds enough land in a quarter section of ground to feed a family in some of our less prosperous countries.

In closing, I would like to quote from the letter head on our North Central Weed Control Conference stationery, "Agriculture is a controversy with weeds." With this, I believe, we will all agree.

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[1] Chief, Weed and Seed Division, Nebraska Department of Agriculture and Inspection, Lincoln, Nebraska.

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PRESENTATION OF AWARDS

Mr. W. H. Kircher, Managing Editor of The Farmer, St. Paul, Minnesota, introduced G. D. Webster of Elbow, Saskatchewan, as the outstanding Extension Worker, and Victor Hagberg, Nobles County Weed and Seed Inspector, Worthington, Minnesota, as the outstanding Regulatory Worker. Abstracts of their reports follow.

WEED CONTROL WORK, ELBOW, SASKATCHEWAN

G. D. Webster

1956 was the first year in the organized weed control program and nearly all effort was spent in educating farmers to know their weeds, especially persistent perennials, and to explain control measures. We know it has been very successful, as farmers reported toadflax infestations on over 250 quarter sections because of this education.

In 1957, we set up a weed committee consisting of four farmers and Ag. Rep. This committee, financed by the R. M.'s, hires two weed supervisors and pays their salary and expenses. These men meet once a month to discuss weed control problems, arrange meetings, tours, demonstrations, etc., and to make recommendations. Excellent results.

We conducted 60 method demonstrations, attended by 1,600 people, and put out 45 result demonstrations. We held two weed tours, attended by 80 people, and two training schools. We put out 5 news stories, 24 exhibits, and made over 75 contacts with Federal, state, utility, and private agencies. We contacted over 700 individuals on weed problems.

WEED AND SEED CONTROL PROGRAM, NOBLES COUNTY, 1957

Victor Hagberg

Personal. In 1938, when I had been farming in Nobles County for seventeen years, I was elected township supervisor. In the spring of 1949, I moved into Worthington and shortly thereafter was appointed county weed and seed inspector.

Having been a farmer since boyhood and a township supervisor for eleven years, I felt at least partly qualified for the job. I have, however, gained much from attendance at each year's Short Course for county weed and seed inspectors.

Organization of program. In Nobles County, I am fortunate in having a very cooperative county board.

The township boards and village councils are by law directly in charge of their weed problems. Only one deputy was appointed by the townships but half of the villages have deputies.

In the 20 townships of the county, we have 80 weed inspectors, the three supervisors and the clerk. Under best conditions, all take part in the weed inspection work in their township.

Each year in February and March, I meet with each of the town boards. We sit down around a table and, taking out the plat book, we check the badly infested farms. Notices are sent out to the owners and occupants of such farms asking them to cooperate with us in the weed problem on their farms. We ask them to plant badly infested land to a crop which can be sprayed. This method, with a notice that comes from both the supervisors and the weed man, is very effective. I have gained valuable information and help from district supervisor Gilbert Olson.

Nobles County. Nobles County was organized as a county May 23, 1857. It is located in the southwestern part of the state and is bounded on the south by the state of Iowa. The county consists of 20 townships, 11 incorporated villages and 3 unincorporated villages, with Worthington as the county seat. The county has a population of 23,000 and the population of the county seat is 8,000. Most of the people in the county are of German, Hollander and Scandinavian descent. The soil consists of black loam, with clay subsoil. The county covers 455,680 acres, with 255,900 acres of crop land and has never known a crop failure. Corn and soybeans are the major cash crops, with some oats and flax. Worthington is known as "The Turkey Capital of the World."

Weed problems of Nobles County. Canada thistle is a major weed problem in our county. Cocklebur has become a serious menace, largely due to the increase in soybeans. Field bindweed, leafy spurge and sowthistle infestations have been gradually eliminated, and very few of these plants now exist in the county. As broadleaf weeds are being eradicated grass weeds are on the increase.

Control of weeds in Nobles County. Control of weeds in small grains is through the use of 2,4-D by spraying when the grain has stooled out and followed up with a second spraying after harvest.

Weeds in corn are being eradicated with cultivation, by spraying with 2,4-D when the corn is 3 to 6 inches in height, and by a second spraying at lay-by stage, either with a regular field sprayer or a hi-boy.

A large number of small infestations are eliminated with the use of soil sterilants. Roguing of weeds in corn and soybeans is a practice carried out by many of our farmers.

A considerable amount of alfalfa is sowed annually for the purpose of controlling weeds, and much of this crop is processed through a dehydrating plant in our county. Some 27,600 acres of alfalfa are raised annually, or 10.7% of the crop acreage of our county, with 62% of our crop land being planted to a row crop.

Chemicals used:

Number of gallons of 2,4-D	21,255
Number of gallons of brush killer	263
Number of gallons of MCP	1,009
Number of pounds of TCA	664
Number of pounds of Amino Triazole	1,576
Number of pounds of soil sterilizing chemicals	10,622

* * *

Acres on which weed infestations were controlled with chemicals, mainly by spraying:

Oats, wheat, barley and flax with 2,4-D	66,000
Flax with MCP	800
Flax with TCA	80
Flax with MCP and TCA	150
Corn with 2,4-D	90,000
Pasture and brush with brush killer	1,400
Percentage of grain sprayed in county	58.81%

* * *

Annual plant industry meeting. Following the Short Course in St. Paul, the Annual Plant Industry Conference was held in the county. All township board members and village mayors and their assistants were invited to attend as required by law. An invitation was extended to anyone interested through news stories in local papers.

Representatives of the state department of agriculture, the county agent and I conducted the meeting.

We had a good attendance, with all townships and most of the villages represented. Beside a general discussion of pests and control measures, local officials were instructed as to their duties and the newest methods in controlling pest problems.

Local meetings. With the help of the county agent, I held 5 meetings to cover the county. They were arranged to give every farmer an opportunity to attend one of the meetings. Highlights of the program were seed labeling, new chemicals, and insect pests. We showed slides and used a film. The total attendance was 382.

Publicity used. In addition to the meetings which focused attention on some parts of the weed program I used newspaper publicity and the radio.

Beside news stories in cooperation with the county agent's office, four ads were published calling attention of owners and operators to the proper control measures for the season and the legal provisions in that regard. Two other ads in regard to seed purity were also published. General news stories and radio programs through the extension office helped to inform people of the practices needed for effective control.

Control program. We have 394 miles of **county roads** in Nobles County and these are supervised by the county engineer. He is very cooperative whenever there are some weeds they have missed or which did not go down when sprayed. I report such cases to them and the crew gets right out and takes care of them. The county has two sprayers. They spray all noxious weeds in the spring and mow all roads in summer and fall. Due to all the rain we had this summer it was a little difficult to get all roadsides mowed at the right time. For mowing and spraying on county roads $15,082 was spent.

We have 129 miles of **state highways** in Nobles County. In working with the state highway department, I find they are very cooperative and willing to get rid of noxious weeds on their roadsides. They spray all weeds and some spots twice, whenever necessary. All roads are mowed twice a year.

We have 2 **railroads** through Nobles County—the Northwestern and the Rock Island. The railroad rights of way total 85 miles and are all sprayed where infested. In some places they are mowed and burned.

The **state** has approximately 80 acres of land in the county. This is sprayed by plane every year. Some attention on the part of the weed inspector has been necessary.

Right-of-way and ditch miles on which chemical measures were taken: state highway, 60; county highway, 125; township roads, 403; power lines, 10; railroad rights of way, 50; county ditches, 15.

Equipment available:

Power sprayers owned by farmers	1,287
Power sprayers owned by county, townships and custom operators	35
Airplane spray service	1
Airplane spraying in 1957, acres	4,900

Contacts made: From January 1 thru September 15, 1957, a total of 1,100 contacts were made with individuals, chemical dealers, state, county, railroad and utility personnel, state and federal agencies, township supervisors and assistants.

County ditches. We have 57 miles of county judicial ditches and several hundred miles of county tile. These ditches are all sprayed. The county has a ditch man who takes care of all county tile and county ditches. He has his own sprayer, so he does a good job on the ditches.

Township roads. We have some 812 miles of roads and we estimate that 403 miles of these were sprayed for noxious weeds and brush. Some of the townships have their own sprayers and they are doing a fine job. I think in the future all townships will have their own sprayers and mowers. I am working on this problem. By having their own equipment, they can get the job done when it should be done.

Meetings, publicity and services. Twenty-five meetings were held during the year with a total attendance of 615. Thirty-five news stories and seven radio programs were prepared. An exhibit was made at the County Fair. Ten sprayers were calibrated and 65 seed samples sent to the State Laboratory.

Expenditures: The townships spent $1,445 for weed inspection and $4,250 for spraying and mowing weeds. The villages spent $225 and $1,807.

Work with local weed problems. In spite of meeting with township boards and interviews with owners and operators of problem farms, the volume of calls reached a high level by mid-May. Fully two-thirds of the 858 contacts made this year were calls between May 15 and August 15.

A typical call concerns an area of Canada thistle that is reaching bloom. The board or village mayor is always contacted before visiting the location unless more information is needed.

Generally, one of the local officials went with me and often a talk with the occupant was all that was needed. However, if I find it necessary I serve Form #1 (36 this year). I call back but generally the town or village has taken care of the follow-up. In general, this method works very well and only 5 cases arose where the area was mowed or sprayed by an outside party, and only 2 of those were not settled for by the owner.

Persistent, year-after-year attention to the problem farms has largely stopped the necessity for destruction of crops in June and July. The first step is the agreement on the part of the landlord and tenant to use crops on infested land that can be sprayed, and good long-run cropping plans such as seeding down.

The second is the build-up of push from the board and neighbors that forces better use of chemicals and clean-up of non-crop land.

Some local control methods. With such large acreages of corn, thistles and other weeds that fit in with this crop have made more trouble. Operators used with success two rather new plans:

1. Spray when corn is small (from time leaves open to 6 inches high). Follow with spray at lay-by. The average rate was 2,4-D at ½ pound per acre.
2. Spray with a high clearance sprayer in August, perhaps following an early spray, using up to 1 pound of 2,4-D per acre.

Seed program in Nobles County. A total of 186 seed inspection contacts were made this year. All depots in the county were checked, as well as farm sales and truckers. A high degree of cooperation was secured. Many service samples from farmers were sent to the laboratory. I was greatly assisted in the job of getting farmers to test their seed by the county Crop Improvement Association. Publicity was also aided by the county Crop Show with its display of good clean seed.

The official samples taken at depots were a means of checking what grade of seed came into the county. Seed peddling has slowed down a lot and the official samples showed up a lot better than in prior years.

During seeding, I visited farmers working in the field and took 20 samples of seed as actually being put in the ground. No reports on 1957 drill box samples have been received as yet, but 1956 samples showed no noxious weeds but did contain such weeds as mustard, which was serious. Good results of spraying on such weeds has tended to make farmers somewhat careless about sowing them.

Out of the samples of seed I sent to the state to be tested, there were only 3 minor violations, such as germination. There was one case where a farmer bought 4 bags of alfalfa seed a year ago and this spring half of the field came up to alfalfa and the other half sweet

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clover. It was impossible to determine whether the seed was labeled wrong because no one could prove which bags were actually used in the field. No sample was retained. This is typical of the case where the question is: what seed was used? Farmers must be warned again and again to retain samples of seed they plant.

Local demonstrations. I assisted in applying two large Amino Triazole demonstrations in 1956 which were carried over into this season.

Three plots were applied with the assistance of the county agent this year on heavy Canada thistle infestations, using Amino Triazole and 2,4-D singly and in combination. Two demonstrations of the effect of a light (2 lb/A) application of Amino Triazole in August in corn were also applied.

Dr. R. S. Dunham, Chairman of the Essay Contest Committee, announced that Frank James Fretwell, of Clive, Alberta, age 16, was the winner of the contest. His paper follows.

HOW WE CONTROL WEEDS ON OUR FARM

By Frank James Fretwell

On prairie farms the control of weeds is usually a major problem. Our farm is no exception, having a variety of weeds with which we must contend. We eradicate these weeds by cultivation, by planting competitive crops, by chemical application, and by avoiding the introduction and spread of new ones.

Cultivation, the aged and common method of controlling weeds, is used extensively on our farm. Immediately after harvesting we till down most of the stubble, causing weeds to begin germinating. This land will get green late in the fall and early in the spring. In this manner many weeds can be killed before seeding. Another good method is to plow the land as early as possible in the spring. Weeds that have been lying dormant in the soil, such as wild oats, will germinate quickly, along with fast growing stinkweed and pigweed. After several weeks we again work this land and seed it. A last-minute way of killing small weeds is to harrow the land shortly after seeding. This idea works most successfully under wet conditions. Every year one quarter of the tillable acreage on our farm is summerfallowed. We find it necessary to cultivate summerfallow frequently, especially when the land is infested with couch grass or thistles. Summerfallowing is still the only practical method of controlling couch grass.

Planting competitive crops has worked well in weed control on our farm. We sow Olli and Gateway barley which ripen quickly and can be harvested before weeds mature. This year we planted Gateway barley. It grew at a surprising rate and matured almost weed free in the middle of August. Olli and Gateway are excellent for use in the control of wild oats as they mature long before the oats are ripe. In some cases we require a fast growing variety of oats that will serve the same purpose. We have found Larain oats very successful in this regard.

Legumes and grasses are very effective in combating weeds. Our crop rotation plan keeps one quarter of the arable land on our farm sown to grass. This is an excellent way to control many kinds of weeds especially Canada thistle. Three years ago several acres on the home quarter were badly infested with this thistle, making it necessary to skip the swath when combining. The following year we seeded this acreage to alfalfa and brome grass. Today one can walk over it and encounter only the occasional thistle. We are sure the planting of grass will keep thistles from becoming a major problem on our farm. Grass is helpful in controlling stinkweed and pigweed. Mowing the grassland weakens these weeds and they are choked out by the fast growing grass.

To have a farm fairly free of weed infestation we think it necessary to check the spread of weeds as far as possible. Many bad weeds usually spread from sloughs, fence rows and from rough land that is seldom cultivated. Here noxious weeds can grow and spread unchecked and unnoticed. We make a practice of mowing field edges and accessible sloughs. Several years ago sow thistle appeared on our land, especially in low wet places. We mowed the sloughs and field edges where it appeared. In the grain where mowing was unpractical we rogued the weed. Now sow thistle has ceased to be a threat. We have several acres of wild pasture land on the home quarter that had become infested with wild barley, blue burr, stinkweed and pigweed. We ploughed this land to kill the weeds and renew the grass. In several months the grass had formed a new growth and the weeds had disappeared. The idea works even better if grass seed is sown with the operation.

There are times when a farmer must quickly and effectively eradicate persistent weeds before they become a serious problem. Such was the case with hemp nettle on our farm. In the summer of Nineteen Fifty-five, hemp nettle became very abundant on a sixteen acre field. Unfortunately, the weed matured before harvesting and was further spread by combining. This spring we decided spraying would be the only sure method to stop it. The field was sprayed near the end of June and in several weeks the nettle had shrivelled to nothing. Chemicals in powdered form are efficient for controlling small patches of noxious weeds. Several times we have discovered isolated spots of toad flax. We promptly and successfully exterminated this weed with Atlacide powder.

The preceding methods of weed control can be unsuccessful if a farmer carelessly introduces and spreads weeds on his farm. We avoid purchasing bedding or feed that may contain noxious weed seeds. We take precautions with regard to obtaining and growing seed grain. Growing seed on our best wild oat free land is a must. We always get seed grain cleaned even if it is to be used in growing feed. When purchasing fresh seed we always insist on registered or certified grain.

It is my opinion that if a farm is to be a successful enterprize the farmer must keep it free of weeds. He must wage a constant war against them, combining the methods of cultivation, of planting competitive crops, of applying chemicals and sprays, with caution and common sense.

Dr. George F. Warren of Purdue University, Chairman of the Committee on Honorary Membership, introduced Dr. Peter John Olson of the University of Manitoba as the Honorary Member for 1957, and presented him with a scroll, with the following remarks:

It is a privilege to present the Honorary Membership Award this year to a man who truly represents the two great countries who have membership in our conference; for Dr. Peter John Olson has lived and made real contributions to Agriculture on both sides of the border between the United States and Canada.

Dr. Olson was born on a farm at Grafton, North Dakota in 1887 and received his Bachelor of Science degree from North Dakota Agricultural College in 1910. He later earned his Master of Science degree from the University of Illinois and his Doctorate from the University of Nebraska.

Following graduation from college, Dr. Olson's first position was as a teacher of Agriculture and Biological sciences in the high school at Alexandria, Minnesota. This was the start of an outstanding career in agriculture in which both teaching and research were to be pursued.

At the University of Minnesota he was Assistant Professor of Agronomy and Assistant Agronomist in the Experiment Station. Later he returned to his native state where at the North Dakota Agricultural Experiment Station he pioneered in the development of early-maturing high yielding corn hybrids adapted to the area. From 1934 to 1937 he served as Assistant Dean and Assistant Director of the North Dakota Experiment Station.

In 1937, Dr. Olson started his Canadian career as Head of the Plant Science Division at the University of Manitoba. In this position he became active in research with forage crops and small grains. It was here also that he became interested in weed control. In this field of research he is perhaps best known for his basic studies on the effect of herbicides on small grains at different stages of growth. The thoroughness with which these studies were conducted is indicated by the fact that they have been the basis for many of the present recommendations for the use of herbicides on these crops.

The long list of Dr. Olson's scientific publications includes many that are classics; but impressive as his research contributions have been they can hardly overshadow his accomplishments as a teacher. Not only has he trained graduate students in the precise and thorough methods of research that have been characteristic of his own work but he has been equally successful in teaching undergraduate students and farmers. He can be justly proud of the men he has trained.

Dr. Olson is a member of several honorary and professional organizations including Sigma Xi, Phi Kappa Phi, Alpha Zeta, Gamma Sigma Delta and the American Society of Agronomy. He is a fellow of the American Association for the Advancement of Science and the Agricultural Institute of Canada and is a charter member and the first honorary life member of the Manitoba Institute of Agrologists.

He has been active for many years in the North Central Weed Control Conference and he and his graduate students have made frequent and important contributions to our Conference publications. As a member of the Research Committee he has helped greatly in making sound recommendations for the use of herbicides.

Dr. Olson retired from the University of Manitoba two years ago and is now operating farms on both sides of the border. Since he is living in North Dakota he decided about two weeks ago that he should not favor one country over another so has accepted a position as Director of Farm Programs for radio station CFAM at Altoona, Manitoba. Dr. Olson, it is a privilege and pleasure to present you with the Honorary Membership Award in behalf of the North Central Weed Control Conference.

HONORARY MEMBERS
NORTH CENTRAL WEED CONTROL
CONFERENCE

It seems appropriate to list here the Honorary Members of the NCWCC. The first one was chosen in 1948.

1948 L. W. Kephart
1949 A. H. Larson
1950 J. Walter Zahnley
1951 Posthumous citations of T. R. Yost and R. F. Fuelleman
1952 Henry E. Wood
1953 Walter C. Dutton, George Briggs
1954 A. L. Bakke
1955 C. J. Willard
1956 R. S. Dunham
1957 P. J. Olson

RESOLUTIONS

NORTH CENTRAL WEED CONTROL CONFERENCE INC.

1957 Des Moines, Iowa

WHEREAS, the N.C.W.C.C. appreciates the arrangements that have been made and the excellent facilities provided for this 14th Annual Conference: NOW, THEREFORE, BE IT RESOLVED that we express our appreciation and thanks to the State of Iowa, the City of Des Moines, the Des Moines Chamber of Commerce, the Staffs of Iowa State College and the Iowa Department of Agriculture, and particularly Dr. E. P. Sylvester and Mr. Loyd Van Patten of the local arrangements committee, and to the Midwest Farm Paper Unit for providing the attractive programs.

FURTHERMORE, BE IT RESOLVED that this Conference express its thanks to Dr. C. E. Minarik, Chief of the Crops Division, Biological Warfare Laboratories, Ft. Detrick, Maryland, for his informative address, and to all others who participated in making the Conference Program a success.

WHEREAS, the N.C.W.C.C. has greatly benefited from work done by the Division of Weed Investigations of the U.S.D.A.: NOW, THEREFORE, BE IT RESOLVED that this Conference express its appreciation for those contributions in the field of weed control.

WHERAS, the N.C.W.C.C. has benefited by the fine exhibits in evidence this year: NOW, THEREFORE, BE IT RESOLVED that the Conference express its appreciation and thanks to the individuals and concerns that have cooperated by displaying their products.

WHEREAS, the field of weed control has experienced a rapid expansion during the past decade and weed control has become a major factor in efficient crop production; NOW, THEREFORE, BE IT RESOLVED that the N.C.W.C.C. urge the U. S. Department of Agriculture to consider the possibility of publishing in the near future a Yearbook on weeds and their control.

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REGISTRATION LIST

NORTH CENTRAL WEED CONTROL CONFERENCE

Des Moines, Iowa

December 10, 11, 12, 1957

A

Aalto, T. R.—Heyden Newport Chemical Corp., 342 Madison Avenue, New York 17, New York
Aanestad, Arden—DuPont Chemical Company, 1207 Foshay Tower, Minneapolis, Minnesota
Abernathy, M. B.—Continental Oil Company, Room 1801 Fair Building, Fort Worth, Texas
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Ausenhus, Clarence—Midland Cooperatives Inc., 739 Johnson Street, Minneapolis, Minnesota

B

Bachus, Arthur—Cedar Company, Bennett, Iowa
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Baggerly, A. Arold L.—Townsend Tree Service Co., Munice, Indiana
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Bartels, W. F.—Bartels & Shores Chemical, 1400 St. Louis Avenue, Kansas City, Missouri
Bartley, Clayton E.—Geigy Chemical Corporation, Saw Mill River Road, Ardsley, New York
Bartzat, L. W.—Agrifirst Chemical Corp., 2400 West O Street, Lincoln, Nebraska
Bayer, David E.—University of Wisconsin, Agronomy Department, Madison, Wisconsin
Beardsley, Lee N.—Delavan Mfg. Co., West Des Moines, Iowa
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Beatty, Robert H.—American Chemical Paint Co., Ambler, Pennsylvania
Bell, Raymond—Raymond Bell Spray Service, Prairie City, Iowa
Bendall, T. L.—Dow Chemical Company, 615 E. Larking Street, Midland, Michigan
Benkert, Roy F.—Warren Douglas Chemical Company, 128 S. E. 26th, Des Moines, Iowa
Bennett, H. B.—Bennett Explosives Inc., 500 E. Butler Street, Manchester, Iowa
Berggren, Fred H.—Hooker Electrochemical Company, Buffalo Avenue, Niagara Falls, New York
Berry, John F.—Worth County, Northwood, Iowa
Billeter, M. J.—Bristol Grain & Seed, Bristol, Illinois
Billings, E. M.—Monsanto Chemical Co., Lindbergh & Olive St. Rds., Saint Louis, Missouri

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Registration List (Continued)

Billstein, Arthur E. F.—Pennsylvania Railroad, Penn. R. R. Laboratory, Altoona, Pennsylvania
Bingeman, Carl W.—DuPont Chemical Company, Grasselli Chemicals, DuPont, Wilmington, Delaware
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Campbell, Maurice A.—Garst & Thomas Hybrid Corn Co., Coon Rapids, Iowa
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Catherwood, James J.—J. C. Robinson Seed Co., Waterloo, Nebraska
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Registration List (Continued)

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Feinberg, Chester—Diamond Alkali Company, Newark, New Jersey
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Flintrop, John—County of Waseca, Waseca, Minnesota
Foley, Clarence E.—County Weed Commissioner, Northwood, Iowa
Folkedale, J. B.—Habie Mfg., Clarion, Iowa
Fortmeyer, Darle F.—Hawkeye Spraying Service, Goodland, Kansas
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Registration List (Continued)

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Friesen, George—The University of Manitoba, 33 Oriole St., Winnipeg 9, Canada
Friesen, H. A.—Department of Agriculture, Lacombe, Alberta, Canada
Fulton, Bob—Alden, Minnesota
Furman, Richard H.—R. R. 1, Iowa Falls, Iowa
Furrer, John—College of Agriculture, Agronomy Dept., Lincoln, Nebraska
Fuxa, Fay—Miller Chemical Co., 525 No. 15th Street, Omaha, Nebraska

G

Gale, Richard L.—Agricultural Service Co., 601 N. Main, Centerville, Iowa
Gallagher, John E.—American Chemical Paint Company, Ambler, Pennsylvania
Gandrud, E. S.—Gandy Company, Owatonna, Minnesota
Gantz, Ralph L.—University of Illinois, Urbana, Illinois
Garez, Harold—The Gardeners Sales Ltd., 970 Mulvey Avenue, Winnipeg, Manitoba, Canada
Garimorth, Johana—D204 Adams Hall, Madison 10, Wisconsin
Garrett, Deloss—Weed Commissioner, 507 East 5th Street, Carroll, Iowa
Geary, F. A.—Standard Oil, 910 S. Michigan Avenue, Chicago, Illinois
Gemmell, L. G.—Geigy Chem. Corp., P. O. Box 430, Yonkers, New York
Gerdes, E. C.—Diamond Black Leaf Co., 300 Union Commerce Bldg., Cleveland 20, Ohio
Gerdes, G. H.—Sac County, Wall Lake, Iowa
Girardot, Carroll—Agrifirst Chemical Corp., 2400 West "O" St., Lincoln, Nebraska
Gleason, Lowell S.—Monsanto Chemical Co., Olive St. Rd. and Lindbergh, Saint Louis 24, Missouri
Gorman, Frank—New Hampton, Virginia
Gorman, John J.—Floyd County Court House, Charles City, Iowa
Gratz, Marlin—Stokely Van-Camp, E. Ninth St., Fairmont, Minnesota
Graves, H. D.—Hart Equipment Co., Rockton, Illinois
Graznak, Michael—M. F. A. Oil Co., 201 South 7th, Columbia, Missouri
Green, John G.—NDAC Experiment Station, Botany Department, NDAC, Fargo, North Dakota
Greig, J. K.—Department of Horticulture, Kansas State College, Manhattan, Kansas
Greiner, Leonard—Alden, Iowa
Griffin, Peter—California Spray Chemical, 4603 F Ave. NE, Cedar Rapids, Iowa
Grigsby, Buford H.—Michigan State University, 201 Haslett Street, East Lansing, Michigan
Grindle, Harold—State Department of Agriculture, Malvern, Iowa
Gull, P. W.—Spencer Chem. Co., 610 Dwight Bldg., Kansas City, Missouri
Gullikson, Glenn—Dow Chemical Company, Midland, Michigan
Guth, D. O.—Guth Chemical Company, 1135 W. Fullerton Avenue, Chicago 14, Illinois

H

Hagberg, Victor—Nobles County, 1030 Oslo Street, Worthington, Minnesota
Hahn, Lloyd—Hahn Inc., 1825 W. Franklin, Evansville, Indiana
Hale, Floyd H.—Stokely-Van Camp, 804 E. 2nd, Fairmont, Minnesota
Ham, George F.—Diamond Alkali Co., Painesville, Ohio
Hamilton, George A.—Extension Service, Scotts Bluff County, Post Office, Scottsbluff, Nebraska
Hamilton, George—Geigy Agr. Chem., Saw Mill River Road, Ardsley, New York
Hamilton, Robert H. Jr.—USDA Weed Control, Dept. of Botany, Michigan State U., E. Lansing, Michigan
Hannah, Charles P.—Jefferson Co. Weed Dept., Oskaloosa, Kansas
Hans, Wm.—Floyd County, Rudd, Iowa
Hansen, Henry L.—School of Forestry, University of Minnesota, Saint Paul, Minnesota
Hanson, Craig—Midland Cooperatives Inc., 739 Johnson, Minneapolis, Minnesota
Hanson, H. C.—Hanson Equipment Co., Beloit, Wisconsin
Harl, Neil E.—Wallaces' Farmer, 1912 Grand Avenue, Des Moines, Iowa
Hart, Ken—Nalco, 6216 W. 66th Place, Chicago, Illinois
Hart, W. H.—The Hart Equipment Co., P. O. Box 575, Rockton, Illinois
Haskett, William C.—The Upjohn Company, Kalamazoo, Michigan
Hawkins, Lewis L.—Roadside Improvement, Iowa State Highway Commission, Ames, Iowa
Hay, J. R.—Canada Department of Agriculture, CEF, Ottawa, Canada
Hayes, E. P.—Washington County, 519 N. Avenue D., Washington, Iowa
Hazer, R. V.—Mo. Pacific Railroad Company, 1200 Mo. Pac. Bldg., St. Louis, Missouri
Heaton, Jack—Hahn Inc., 1825 W. Franklin, Evansville, Indiana
Heikes, Eugene—Montana Extension Service, Bozeman, Montana
Heimbuch, Robert—Heimbuch Imp. Co., Route 4, Mason City, Iowa
Heinzeroth, Ervin—Heinzeroth Spraying Service, Box 19, Alden, Iowa
Helgeson, E. A.—North Dakota Agricultural Exp. Sta., Fargo, North Dakota

XUM

Registration List (Continued)

Hemingwis, H. G.—Cedar County, West Branch, Iowa
Hemphill, Delbert D.—University of Missouri, Columbia, Missouri
Henry, Bill—Iowa County, Ladara, Iowa
Hensing, Ed—Iowa Falls, Iowa
Herrbach, Ernest F.—Standard Oil Co., 910 S. Michigan Ave., Homewood, Illinois
Hertema, G. W.—Lynk Bros. & Baird Hybrid Corn Co., Box 423, Marshalltown, Iowa
Heying, Harold—New Hampton, Iowa
Hiekethies, M. E.—Floyd County, Court House, Charles City, Iowa
Higbee, F. Farrell—Brown Farm Chemical Co., Box 517, Scottsbluff, Nebraska
Hill, Lyle O.—Reasor-Hill Corp., Box 36, Jacksonville, Arkansas
Hilton, Henry F.—PSCI, Public Service Co. of Indiana, Plainfield, Indiana
Hodapp, John F.—The Quaker Oats Co., Warden Bldg., Fort Dodge, Iowa
Hokanson, H.—Roberts County, 209 E. Ash Street, Sisseton, South Dakota
Holdeman, Ralph K.—Chase County, 521 Oak, Cottonwood Falls, Kansas
Holen, W. F.—W. H. Barber Co., 825 S. E. Thornton, Minneapolis, Minnesota
Hollenbeck, Carlos—Quick Supply Co., 530 Euclid Avenue, Des Moines, Iowa
Hollingsworth, Clarence—Greenwood County Extension, Court House, Eureka, Kansas
Hollingsworth, E. B.—USDA-ARS, Botany & Plant Path. Dept., Purdue Univ., Lafayette, Indiana
Hollingsworth, W. C.—Des Moines, Mediapolis, Iowa
Holui, LeRoy George—University of Wisconsin, 714 Miomi Pass, Madison, Wisconsin
Holub, Wm. F.—Black Hawk County Weed Commissioner, Hudson, Iowa
Hopkins, Robert, The Nebraska Farmer, 1420 P St., Lincoln 1, Nebraska
Horne, Don—Chipman Chemical Co., Saint Paul, Minnesota
Horst, Elmer W.—County Weed Dept., 107 W. 11th Street, Winfield, Kansas
Howard, Harold H.—Thompson-Hayward Chemical Co., 2915 Southwest Blvd., Kansas City, Missouri
Howden, J. S.—Sherwin-Williams Co., 100 Princess Street, Winnipeg, Manitoba, Canada
Huckstep, E. F.—Allied Chemical & Dye Corp., 1221 Locust Street, Saint Louis, Missouri
Hunt, Merle W.—Ackley, Iowa
Hunt, Walter A.—Kansas Board of Agriculture, Arkansas City, Kansas
Hursh, Allen E.—Hursh Bros., Inc., Amana, Iowa
Hutchinson, John—Kansas State Board of Agriculture, Paradise, Kansas
Hybe, F. W.—Harvey County Weed Office, Newton, Kansas
Hyle, Eldon L.—Hooker Electrochemical Co., Niagara Falls, New York

J

Jacobson, Eldon H.—Minnesota Farm Bureau Service Co., 101 E. Fairfield, Saint Paul, Minnesota
Janssen, Leonard F.—Delavan Mfg. Co., 811 4th St., West Des Moines, Iowa
Jennings, Dee C.—Chemagro Corp., 3100 W. Lake St., Minneapolis 16, Minnesota
Jennish, R. W.—Hypro Engineering Inc., 726 W. O. W. Bldg., Omaha, Nebraska
Jensen, L. A.—N. D. Extension Service, State College Station, Fargo, North Dakota
Jensen, Robert J.—Iowa Farm Supply Co., 1019 High Street, Des Moines, Iowa
Johnson, A. K.—Delavan Mfg. Co., West Des Moines, Iowa
Johnson, Byron G.—Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin
Johnson, Chas.—Story County, Nevada, Iowa
Johnson, Harold Q.—Reno County Noxious Weed Dept., Court House, Hutchinson, Kansas
Johnson, Kenneth W.—Iowa State College, 612 Brookridge, Ames, Iowa
Johnson, Richard A.—Minn. Crop Improvement Ass'n., Waseca School of Agri., Waseca, Minnesota
Johnston, Esther—Industrial Service Lab., Ankeny, Iowa
Jones, Buford—Oklahoma Dept. of Agriculture, State Capitol, Oklahoma City, Okla.
Jones, Warren—Ag. Services Inc., 402 Flour Exchange, Minneapolis, Minnesota
Josephs, Melvin J.—The Dow Chemical Co., Midland, Michigan
Joyce, Don—Gen. Chem. Div., Allied Chem. and Dye Co., Mench, Montana

K

Karsjens, Raymond—Harden County Weed Comm., Court House, Steamboat Rock, Iowa
Keene, Robert E.—Delavan Mfg. Co., 811 - 4th Street, West Des Moines, Iowa
Keepper, Mel—Van Horn Hybrids, Cerro Gordo, Illinois
Kemmer, Peter M.—Howard Co., Lime Springs, Iowa
King, L. J.—Carbide-Boyce Thompson, 1086 N. Broadway, Yonkers, New York
Kircher, Wm. H.—The Farmer, 55 E. 10th St., Saint Paul 2, Minnesota
Klages, Forest—Floyd County, R. R. #4, Charles City, Iowa
Kline, Lloyd—Wallaces' Farmer, 1912 Grand Avenue, Des Moines, Iowa
Knobbs, Thomas P.—Weed Commissioner, Montrose, Iowa
Kommedahl, Thor—Univ. of Minnesota, Dept. of Plant Path. and Botany, Saint Paul 1, Minnesota
Krejci, Allan E.—State Weed Office, State Capitol, Lincoln, Nebraska

XUM

Registration List (Continued)

L

Lambert, Dwight W.—Nebraska Weed & Seed Division, 4126 Saint Paul, Lincoln, Nebraska
Lambert, W. L.—Corn States Hybrid Service, 803 Keo Way, Des Moines, Iowa
Lancaster, J. A.—Townsend Tree Serv., P. O. Box 961, Muncie, Indiana
Lang, Dick—Consumers Cooperative Ass'n., 1500 Iron Dr., Kansas City, Missouri
Larson, Joe L.—Wright County Weed Commissioner, Clarion, Iowa
Lauger, William—State of Illinois, 595 S. State St., Elgin, Illinois
Laverty, Chuck—Laverty Sprayers, Indianola, Iowa
Lawrence, George—Diamond Black Leaf Co., Vandalia Road, Des Moines, Iowa
Lawrence, George W.—Libby McNeill & Libby, 717 7th Ave. N. W., Rochester, Minnesota
Lee, Oliver—Purdue University, Botany Department, Lafayette, Indiana
Lenz, A. H.—American Tel. & Tel. Co., 20 N. Wacker Drive, Room 744, Chicago 6, Illinois
Leinfelder, Richard P.—Chapman Chemical Co., 540 Lexton Bldg., Minneapolis, Minnesota
Leming, William E.—Eastern Iowa Light & Power Coop., Box 124, Wilton Junction, Iowa
Liljedahl, Louis A.—U. S. Dept. of Agriculture, Univ. of Minnesota, Minneapolis, Minnesota
Lilly, J. H.—Iowa State College, 253 Science Bldg., Ames, Iowa
Linck, A. J.—Univ. of Minnesota, Dept. of Pl. Path. and Botany, Saint Paul, Minnesota
Lindaberry, Harold—Pennsalt Chemicals, 309 Graham Bldg., Aurora, Illinois
Linscott, Dean L.—ARS-USDA, Univ. of Nebraska, Lincoln, Nebraska
Little, Reuel W.—Reuel Little Tree Injection Co., Box 288, Madill, Oklahoma
Lloyd, Ralph R. Jr.—Olin Mathieson Chemical Corp., Box 991, Little Rock, Arkansas
Lobay, William—Dept. of Agriculture, Legislative Building, Edmonton, Alberta, Canada
Loekwood, F. H.—Standard Oil, 5310 W. Capital Drive, Milwaukee, Wisconsin
Loeser, Lee—Reade Mfg. Co., 9500 S. Cottage Grove Ave., Chicago 28, Illinois
Long, Larry—"Croplife," 2501 Wayzata, Minneapolis, Minnesota
Loomis, Walter E.—Iowa State College, Dept. of Botany, Ames, Iowa
Lord, Laval—314 Moore Hall, University of Wis., Madison 6, Wisconsin
Loustalot, A. J.—SESD, USDA, Washington 25, D. C.
Lovely, Walter G.—AERD, ARS, Agr. Engr. Bldg., I. S. C., Ames, Iowa
Ludolph, Wm.—C. M. St. P. & P. Railroad, 898 Union Station, Chicago 6, Illinois
Luebke, Norm—Hanson Equip. Co., Beloit, Wisconsin
Luoma, Ed.—Diamond Black Leaf Co., Minneapolis 22, Minnesota

M

Macdonald, B. C.—General Chemical Division, 2020 Broadway N. E., Minneapolis, Minnesota
McCambridge, J. R.—Chipman Chemical Co., 608 So. Dearborn Street, Chicago, Illinois
McCarty, M. K.—USDA-ARS Crops Res. Div., Univ. of Nebraska, Lincoln, Nebraska
McClure, Charles P.—W. H. Barber Co., 825 Thornton S. E., Minneapolis, Minnesota
McCoy, W. J.—The Dow Chemical Co., 1750 Hennepin Ave., Minneapolis, Minnesota
McIntyre, Charles B.—Stauffer Chem. Co., 424 Robert St., Ft. Atkinson, Wisconsin
McKown, Ira—Hennepin County, Maple Plain, Minnesota
McLane, H. R.—Private Brands Inc., 300 S. 3rd., Kansas City 18, Kansas
McMillin, Ed. S.—Wapello County, Court House, Ottumwa, Iowa
McNally, Jack—Delavan Mfg. Co., West Des Moines, Iowa
Mahlstede, J. P.—Iowa State College, Dept. of Horticulture, Ames, Iowa
Marantz, B. B.—Interprovincial Cooperatives Ltd., 144 Lombard Ave., Winnipeg, Manitoba
Marr, Joha—E-Z-Flo Chemical Co., P. O. Box 808, Lansing, Michigan
Marvin, Philip H.—Homar Agricultural Chemical, Post Office Box 2381, Manhattan, Kansas
Mason, Max—Thompson-Hayward Chemical Co., 1110 S. 4th, Omaha, Nebraska
May, W. P.—Cornhusker Feed & Supply, 4006 Holly Road, Lincoln, Nebraska
Meehan, Joseph R.—Minerals & Chemicals Corp., Menlo Park, New Jersey
Melander, L. W.—American Chemical Paint Co., 1439 Hythe Street, Saint Paul, Minnesota
Mercer, M. E.—Spraying Systems Co., 4738 W. Lisbon Ave., Milwaukee, Wisconsin
Merrick, F. L.—Floyd County, Charles City, Iowa
Milbrath, Mel—Midland Coop. Inc., 739 Johnson St. N. E., Minneapolis, Minnesota
Miles, A. R.—State Dept. of Agriculture, Des Moines, Iowa
Miller, Elmer M.—National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Illinois
Miller, Frank W.—Diamond Black Leaf Producers, 3525 Vandalia Rd., Des Moines, Iowa
Miller, R. G.—Laverty Seed Farms, Indianola, Iowa
Miller, Warren—State Dept. of Agriculture, Pierre, South Dakota
Minarik, Charles E.—Fort Detrick, Frederick, Maryland
Miner, Dick—Valley Bag and Supply, East Grand Forks, Minnesota
Minsky, I.—Reade Mfg. Co. Inc., 135 Hoboken Ave., Jersey City, New Jersey
Miscall, Jack L.—Oberdorfer Foundries, Syracuse, New York
Monson, Warren G.—University of Nebraska, Agronomy Dept., Lincoln, Nebraska

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Registration List (Continued)

Moore, Don—Farmrite Sprayer Inc., Juneau, Wisconsin
Moore, Glenn D.—Northrup, King & Co., 1500 Jackson St. N. E., Minneapolis 13, Minnesota
Moorehead, F. G.—Ida County, Court House, Ida Grove, Iowa
Moreau, R. C.—Swift & Co. Agr. Chem. Div., 150 Marble St., Hammond, Indiana
Morgan, Billie S.—U. S. Rubber Co., Naugatuck Chem. Div., Bethany, Conn.
Morre, D. James F.—Purdue University, Life Science Building, Dept. of Bot. and Plant Path., Lafayette, Indiana
Morrow, Joe—Dakota Improved Seed Co., Emmetsburg, Iowa
Moudry, Leonard G.—Howard County, Box 214, Cresco, Iowa
Moyer, William—Moyer Chemical Co., Sioux Falls, South Dakota
Mueller, Robert M.—Private Brands Inc., 300 South 3rd St., Kansas City, Kansas
Murphy, Douglas R.—Stauffer Chemical Co., Box 222, South Omaha Station, Omaha, Nebraska

N

Nash, Russel L.—Nebraska Dept. of Agriculture, Weed & Seed Division, Lincoln, Nebraska
Neitzke, Edwin J.—The Dow Chemical Co., 6000 W. Touhy Ave., Chicago 31, Illinois
Nelson, Donald C.—Univ. of Minnesota, Dept. of Horticulture, Saint Paul, Minnesota
Nelson, Kenneth C.—Univ. Ext. Service, Court House, Baraboo, Wisconsin
Nelson, Maurice—The Farmwell Company, Inc., Ixonia, Wisconsin
Newlin, Owen J.—Pioneer Hi-Bred Corn Company, Production Department, Johnston, Iowa
Niedert, Howard—Howard County, Cresco, Iowa
Nieoll, L. M.—Cedar County, Mechanicsville, Iowa
Nohejl, Tom—Nalco, 6216 W. 66th Place, Chicago, Illinois
Northrop, Ray—Associated Sales & Supply Co., 5137 Southwest Ave., Saint Louis 10, Missouri
Norton, Chas. M.—Olin Mathieson Chem. Co., 10 Light St., Baltimore 7, Maryland
Null, L. M.—Null Seed Farms, Colchester, Illinois
Nylund, Robert E.—Univ. of Minnesota, Dept. of Horticulture, Saint Paul 1, Minn.

O

Oberhauser, S. J.—Agric. Agent, C. M. St. P. & P. Railroad, 940 McKnight Bldg., Minneapolis, Minnesota
Oberts, David G.—Green Giant Co., Beaver Dam, Wisconsin
Oehler, W. P.—John Deere Planter Works, Moline, Illinois
Ogden, Delmar B.—American Crystal Sugar Co., East Grand Forks, Minnesota
Ogilvy, F. Robert—United States Borax & Chemical Corp., 2803 62nd St. Des Moines 10, Iowa
Ogle, Earl—Hercules Powder Co., 115 S. Bemiston Ave., St. Louis 5, Missouri
Ohle, Lester C.—Geigy Ag. Chem., 2270 E. 64th N., Kansas City 16, Missouri
Oitker, E. W.—Standard Oil Co., 8400 Maryland, Saint Louis, Missouri
Olcott, Robert—Monsanto Chemical Company, 1335 - 39th, Des Moines, Iowa
Olson, Grant H.—Iowa County, Manngo, Iowa
Olson, P. J.—CFAM Radio Station, Altona, Manitoba, Canada
Orlik, Robert J.—Diamond Alkali Company, Cleveland, Ohio
Otis, Chet—The Dow Chemical Company, Midland, Michigan
Otto, F. J.—DuPont Chem. Co., Rt. #4, Niles, Michigan
Owens, S. J.—Minneapolis and Saint Louis Railway Co., 111 E. Franklin Ave., Minneapolis, Minnesota

P

Pacelli, Alfred J.—New York Central Railroad, 466 Lexington Ave., New York, New York
Papier, David—Ohio Division of Wildlife, 1500 Dublin Rd., Columbus, Ohio
Parris, Cleston G.—Assoc. of American Railroads, 3140 S. Federal St., Chicago 16, Ill.
Pass, Herbert A.—Sherwin-Williams Co., 2875 Centre St., Montreal, Quebec, Canada
Patton, Byron—Marion County Weed Dept., Marion County Court House, Marion, Kansas
Pauli, Ray—Farmrite Sprayer, Juneau, Wisconsin
Paulsen, L. C.—Boone, Iowa
Peebler, Ralph V.—Capper's Farmer, 912 Kansas Ave., Topeka, Kansas
Peters, Elroy J.—USDA, 108 Waters Hall, Columbia, Missouri
Peterson, Don—University of Wisconsin, Agronomy Department, Madison, Wisconsin
Phillips, E. W.—Woodbury Chemical, 3848 E. 14th, Des Moines, Iowa
Phillips, W. M.—USDA, Ft. Hays Experiment Station, Hays, Kansas
Pierpont, Roger L.—Gen. Chem. Div., Allied Chem. & Dye Corp., Columbia Road, Morris Township, New Jersey
Pintcke, Irwin E.—American Chemical Paint Co., Ambler, Pennsylvania
Plant, E. K.—Columbia-Southern Chemical Corp., One Gateway Center, Pittsburgh 22, Pennsylvania
Porter, Geo.—Adair County Weed Commissioner, Stuart, Iowa
Priola, Mike A.—Shell Chemical Corp., 1221 Locust Street, Saint Louis 3, Missouri
Prueitt, Neil E.—J. M. Hunt & Son, Ackley, Iowa
Pryor, D. K.—Murray County, Slayton, Minnesota

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Registration List (Continued)

Pugh, Stewart G.—Chipman Chemicals Ltd., 1040 Lynn Ave., Winnipeg, Manitoba
Putnam, D. H.—Butler County Weed Dept., 315 N. Taylor, Eldorado, Kansas

Q

Quattrochi, Leonard P.—Chemagro Corp., 5619 St. John, Kansas City 20, Missouri

R

Racek, Val—Farmer and Custom Sprayer, Hurley, Iowa
Ragan, Howard—Birds Eye Div., General Foods Corp., Waseca, Minnesota
Ragsdale, O. M.—Standard Oil Co., 111 State, Ames, Iowa
Raines, R. Glenn—Iowa State Hort. Society, Horticulture Dept., State House, Des Moines, Iowa
Rake, D. W.—U. S. Borax and Chemical Corp., 412 Crescent Way, Anaheim, California
Rao, R. S.—Kansas State College, 359 N 14th St., Manhattan, Kansas
Rasmussen, Carl—H. & R. Implement, Riceville, Iowa
Reade, Richard—Mid-Continent Aerial Sprayers, Hayti, Missouri
Reed, Dale—Slayton Hs. Chem. Co., Slayton, Minnesota
Reed, Frank E.—Spraying Systems Co., Bellwood, Illinois
Reed, J. Harley—Dept. of Agriculture, Hotel Holst, Boone, Iowa
Reichert, Donald D.—Monsanto Chemical Company, Saint Louis, Missouri
Rice, Harold E.—Webster County, Court House, Fort Dodge, Iowa
Richards, Howard T.—Wisconsin Dept. Agriculture, Seed & Weed Section, Agronomy Building, Madison 6, Wisconsin
Rieck, Harry H.—Poweshiek County, Brooklyn, Iowa
Ries, Stan—Michigan State University—Dept. of Horticulture, East Lansing, Michigan
Rittgers, Walter—Pioneer Hi-Bred Corn Co.—Johnston, Iowa
Rodosky, Joe A.—Wapello Co.—Eldon, Iowa
Roe, Eugene I.—U. S. Forest Service—Lake States Forest Expt. Station, Grand Rapids, Mich.
Roensch, Henry—E. S. Gandrud Co.—144 Coolidge St., Owatonna, Minnesota
Roger, Jim—N. S. Koos & Son—4500 - 13th Court, Kenosha, Wisconsin
Rogers, Bruce J.—Purdue University—Dept. of Botany & Plant Path., Lafayette, Indiana
Rogers, Donald E. A.—D. & R. G. W. Railway—W. 8th & Osage, Denver 4, Colorado
Roland, L. A.—Hardin County—Alden, Iowa
Rostberg, Marvin—General Chemical—Larimore, North Dakota
Rotramel, Jack G.—Monsanto Chemical Co.—Box 294, Worthington, Ohio
Ruch, Lewis—Michigan Conservation Dept.—Game Division, Mason Building, Lansing, Michigan
Rusca, Joe—Taylor Weed Commissioner—Athelstan, Iowa
Rutan, George—Spra White Chem Co.—436 G. Ave. N. W., Cedar Rapids, Iowa

S

Sadler, H. J.—Hypro Eng. Inc.—700 - 39th Ave. N. E., Minneapolis, Minnesota
Salmonson, Gordon S.—Pennsalt Chemicals Corp.—Aurora, Illinois
Sand, Paul F.—Univ. of Nebraska—College of Agriculture, Lincoln, Nebraska
Sanderson, Cecil D.—County Extension Service—Sisseton, South Dakota
Schaap, Otto C.—Mutual Dealers Whl.—2361 Hampden, Saint Paul, Minnesota
Schery, Robert W.—Lawn Institute—Rt. 4, Marysville, Ohio
Schmierer, E. H.—United States Borax & Chem. Co.—3456 Peterson, Chicago, Illinois
Schneider, Edwin—Geigy Chem. Co.—Ardsley, New York
Schneider, H. R.—Allied Chemical & Dye Corp.—40 Rector Street, New York 6, New York
Schoech, Ernest G.—Wapello County Weed Commissioner—Blakesburg, Iowa
Schornack, Allen—DuPont Co.—4314 No. 52nd Street, Omaha, Nebraska
Schrader, Clifford H.—Lyon Chemicals Inc.—2305 Hampden Ave., Saint Paul, Minnesota
Schrader, Glenn L.—County Extension Service—Courthouse Annex, Sioux Falls, S. D.
Schroeder, Ray—Associated Sales & Supply Co.—5137 Southwest, St. Louis, Missouri
Schuller, John P.—Stauffer Chemical Co.—445 Harrison St. N. E., Minneapolis, Minnesota
Schwabenlander, Art—Eastern Iowa Light & Power—Wilton Junction, Iowa
Schwietz, Larry—United Petroleum—20th & William Sts., Omaha, Nebraska
Sexsmith, J. J.—Canadian Dept. of Agriculture, Experimental Farm, Leth, Alberta, Canada
Shager, B. J.—Int. Harvester Company—East Moline, Illinois
Shafer, Neal E.—Univ. of Nebraska—Agronomy Dept., Lincoln, Nebraska
Shap, O. O.—Railway Express, Des Moines, Iowa
Shaw, Dwight W.—American Chemical Paint Co.—1920 Locust Street, West Des Moines, Iowa
Shaw, Warren C.—Crops Research Division, ARS, USDA, Beltsville, Maryland
Shepherd, M. H.—Morris Distributing Company—450 W. Ogden Ave., Hinsdale, Illinois
Sherwood, F. R.—American Chemical Paint Co.—Ambler, Pennsylvania
Sherwood, Lloyd V.—Monsanto Chemical Co.—Lindbergh & Olive, St. Louis 24, Missouri
Shirley, James G.—General Chemical Division—2916 No. 56th St., Omaha, Nebraska

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Registration List (Continued)

Siemens, L. B.—University of Manitoba—Plant Science Dept., Winnipeg, Man.
Skaptason, J. S.—Chemagro Corp.—3100 W. Lake, Minneapolis, Minnesota
Slathem, C. G.—County Supervisor—Kensett, Iowa
Slife, Fred W.—Univ. of Illinois—Department of Agronomy, Urbana, Illinois
Smith, Chet—Tri-State Milling Co.—Box 431, Rapid City, South Dakota
Smith, James W.—Huron-Clinton Metro. Auth.—1750 Guardian Bldg., Detroit, Michigan
Smith, W. H.—1965 Muller, Des Moines, Iowa
Smith, Walter L.—American Chemical Paint Co.—515 West Blvd. South, Columbia, Mo.
Smith, Jr., Walton A.—Riverdale Chemical Co.—220 E. 17th St., Chicago Heights, Ill.
Soderdahl, P.—Guth Chemical Co.—1135 W. Fullerton Ave., Chicago, Illinois
Sonderholm, Robert—1132 Oxford, Worthington, Minnesota
Sosalla, Harry—Noble Mfg. Co.—Sac City, Iowa
Spargur, Wm B.—Delavan Mfg. Co.—811 Fourth St., West Des Moines, Iowa
Splets, Al—Associated Producers—Saint Paul, Minnesota
Sprinkle, G. E.—Weed Supervisor—Russell, Kansas
Spry, Clyde—Dept. of Agriculture—Des Moines, Iowa
Spurrier, Earl C.—Univ. of Illinois—213 Davenport Hall, Urbana, Illinois
Stadtherr, R. J.—Univ. of Minnesota—St. Paul Campus, St. Paul 1, Minnesota
Stallings, C. F.—American Tel. & Tel. Company—324 East 11th St., Kansas City, Mo.
Stamm, John J.—Pennsalt Chemicals Corp.—712 East 67th Street, Kansas City, Mo.
Stanford, John P.—Hooker Electrochemical Co.—Niagara Falls, New York
Staniforth, David W.—Iowa State College—Botany Dept., Ames, Iowa
Starrett, J. W.—Monsanto Chem. Co.—Lindbergh & Olive St. Rds., Saint Louis, Mo.
Stau, A. H.—Stafford County—St. John, Kansas
Steier, Elmer J.—Steier Flying Service—Whittemore, Iowa
Steinbauer, George—Michigan State University—Botany Dept., East Lansing, Michigan.
Stephens, Lou—Thompson-Hayward Chem. Co.—SW 1st & Granger Sts., Des Moines, Iowa
Stevens, Roy—Binns & Stevens—1301 High Ave. West, Oskaloosa, Iowa
Steward, Roderick—Steward Farm Chemicals, Inc.—501 Third St. NE, Mason City, Iowa
Stitt, Loyd L.—Velsicol Chemical Corp.—330 E. Groud, Chicago, Illinois
Stower, C. E.—Slayton Agricultural Chem. Co.—1519 Murray Ave., Worthington, Minnesota
Struve, William M.—Iowa State College—Botany Hall, Ames, Iowa
Stucky, H. E.—McPherson County Weed Dept.—Box 105, McPherson, Kansas
Sutherland, J. R. G.—American Cyanamid Co.—5413 North 48 St., Omaha, Nebraska
Sutherland, Melvin L.—American Chemical Point Co.—Ambler, Pennsylvania
Swan, Dean G.—Oregon State College—Box 378, Pendleton, Oregon
Swanson, Ralph—Laverty Sprayers—Indianola, Iowa
Swartz, Evan—Shawnee County Noxious Weed Dept.—Court House, Topeka, Kansas
Swenson, Harold—Cloud County Weed Supervisor—Court House, Concordia, Kansas
Swink, Hugh—Chemagro Corp.—3110 N. Fitzhugh, Dallas, Texas
Switzer, Fred—Imperial Chemical Co.—Shenandoah, Iowa
Sylwester, E. P.—Iowa State College—Extension Service, Botany Hall, Ames, Iowa

T

Taylor, Geo. E—U. S. Rubber, Naugatuck Chem. Div.—1503 Mound Ave., Jacksonville, Ill.
TenPas, Warren E.—John Deere Van Brunt Co.—Harrison, Wisconsin
Thomas, Albert C.—Oklahoma State Dept. of Agriculture—122 State Capitol Bldg., Oklahoma City, Oklahoma
Thomas, Lov—Diamond Alkali Co.—3525 Vandalia Road, Bethael, Kansas
Thomas, Snipes B.—Chemagro Corporation—437 Fifth Avenue, New York 16, New York
Thomason, Paul—Diamond Blackleaf Co.—3525 Vandalia Road, Des Moines, Iowa
Thompson, William D.—Allied Chemical & Dye Corp.—511 E. Patterson, Kalamazoo, Michigan
Thomsen, Norman D.—Diamond Black Leaf—300 Union Commerce Bldg., Cleveland, Ohio
Thornwall, W. C.—Story County, Nevada, Iowa
Thurston, J. William—Delavan Mfg. Co., 811 Fourth St., New York 74, New York
Tibbits, T. W.—Univ. of Wisconsin—Hort. Dept., 552 Toepfer Ave., Madison, Wis.
Tift, Wm.—Hanson Equipment Co.—Beloit, Wisconsin
Tilton, Bill—Risse & Miller, Inc.—Eldora, Iowa
Tison, Haskell—Geigy Chemical Company—125 Carles St., Geneva, Ill.
Tolin, C. E.—Mankato Liquid Fertilizer Service—1230 N. Broad St., Mankato, Minn.
Torkelson, O. J.—Fargo Foundry Co.—92 N. P. Ave., Fargo, North Dakota
Town, Henry G.—Henry Town Labs—3061 E. Washington Ave., Madison 4, Wisconsin
Town, Wayne H.—Diamond Black Leaf Products—Des Moines, Iowa
Townsend, Donald F.—Townsend Tree Service Co.—Muncie, Indiana
Townsend, Vernon E.—Townsend Tree Service Co.—Box 961 Muncie, Yorktown, Indiana
Trask, Allen D.—U. S. Rubber Co.—9 Overwood Rd., Akron, Ohio
Turner, M. B.—American Chemical Paint Co.—Ambler, Pennsylvania

XUM

Registration List (Continued)

U

Ubel, Jake R.—Board of Agri.—State Office Bldg., Topeka, Kansas

V

VanHorn, Lyle—VanHorn Hybrids, Inc.—Cerro Gordo, Illinois
VanScoik, W. S.—American Cyanamid—30 Rockefeller Plaza, New York City, New York
Vavra, Harold—North Dakota Aeronautics Commission—Bismarck, North Dakota
VerStraeten, Charles F.—Iowa Dept. of Agriculture—Des Moines, Iowa

W

Wadleigh, W. "Wad"—Stauffer Chemical Co.—Box 209, Kankakee, Illinois
Wainscott, T. L.—Successful Farming—1716 Locust, Des Moines, Iowa
Walgenbach, Eugene A.—Mammoth Spring Canning Co.—Oakfield, Wisconsin
Walker, Charles R.—Missouri Conservation Commission—Columbia, Missouri
Walker, Dane—Riverdale Chemical Co.—17th & Hanover, Chicago Heights, Illinois
Wallace, Keith—South Dakota State College—Agronomy, Dept., College Station, Brookings, S. D.
Wallberg, John H.—The Dow Chemical Co.—6000 W. Touhy Ave., Chicago 31, Illinois
Walz, Arnold—American Chemical Paint Co.—Sioux City, Iowa
Ward, F. Roger—Peavey Elevators—Grain Exchange Bldg., 6736 Chicago So., Minneapolis, Minn.
Warden, Robet L.—The Dow Chemical Co.—1750 Hennepin, Minneapolis 3, Minnesota
Warren, G. F.—Purdue University—Dept. of Horticulture, Lafayette, Indiana
Warren, Robert L.—Chester Hybrids—P. O. Box 508, Valparaiso, Indiana
Waters, Fred—Henry County—209 North Main, Mount Pleasant, Iowa
Weber, Donald R.—Spraying Systems Co.—3201 Randolph St., Bellwood, Illinois
Webster, Don—Sask. Dept. of Agriculture—Elbow, Saskatchewan
Weeland, Louis—Steuart Farm Chemicals—Mason City, Iowa
Wagrieh, W. Dale—Diamond Alkali Co., P. O. Box 903, Des Moines, Iowa
Weil, Edward D.—Hooker Electrochemical Co.—S. E. 67th St., Niagara Falls, New York
Weimer, Ed—Asplundh Tree Expert Co.—207 Eiler Ave., Louisville 14, Kentucky
Welch, Jim—American Chemical Paint Co.—2503 Robinwood Lane, Denton, Texas
Welker, William V.—Univ. of Wisconsin—Madison, Wisconsin
Wenger, Otto—U. S. Rubber Co.—4135 South Pulaski, Chicago, Illinois
Wensley, G. L.—Fisons Ltd.—Felixstowe, Suffolk, England
West, Sherlie H.—University of Illinois—Urbana, Illinois
Westmoreland, Wm. G.—North Carolina State College—458 Williams Hall, Raleigh, N. C.
Wicks, Gail A.—South Dakota State College—Agronomy Dept., College Station, South Dakota
Wiese, Allen F.—Texas Agricultural Experiment Station, Bushland, Texas
Wilhite, Don—U. S. Borax and Chemical Corp.—1145 Peach Tree NE, Atlanta, Georgia
Willard, Charles J.—The Ohio State University—H. & F. Building, Columbus 10, Ohio
Willette, Donald A.—Willette Seed Farm—Delavan, Minnesota
Williams, G. D.—Deep River, Iowa
Williams, Paul—Olin Mathieson Chemical Corp.—350 N. Clark St., Chicago 10, Ill.
Wilson, Clyde—Monsanto Chemical Co—Monsanto—Saint Louis, Missouri
Wilson, R. C. "Dick"—Cambell Mfg. Co.—Walthill, Nebraska
Wilson, William S.—Socony-Mobil Oil Co., Inc.—59 E. Van Buren, Chicago 5, Ill.
Winter, Orvan V.—Hdqrs. 5th U. S. Army—1660 E. Hyde Park Blvd., Chicago, Illinois
Winters, Robert W.—Union Carbide Chemicals—Three Rivers, Michigan
Wise, Bob—Homar Agricultural Chemicals—502 E. 33 Rd., Wichita, Kansas
Wise, John E.—Spencer Chemical Co.—610 Dwight Bldg., Kansas City, Missouri
Woestemeyer, Vernon W.—U. S. Borax & Chemical Corp.—R. R. 5, Topeka, Kansas
Wolcott, Art—Farmers Union Central Exchange, Billings, Montana
Wolf, Dean—Farm Journal—1524 Duff Avenue, Ames, Iowa
Wolfe, Bob—Corn States Hybrid Service—803 Keo Way, Des Moines, Iowa
Woodbury, H. A.—Woodbury Chemical Co.—Saint Joseph, Missouri
Woods, George—Howard County Supervisor—Route 3, Cresco, Iowa
Wormley, George W.—Farm Journal—Washington Square, Philadelphia 5, Pennsylvania
Worthington, G. F.—Spraying Systems Co.—3201 Randolph St., Bellwood, Illinois
Wright, Walter—Belle Plaine, Iowa

Y

Yahnke, Burdette—Green Giant Co.—LeSueur, Minn.
Yazell, D. H.—Illinois Central Railroad—Chicago 5, Illinois

Z

Zackert, George E.—Imperial Chemical Co.—4th & Grass St., Shenandoah, Iowa
Zedler, Robert J.—Union Carbide—120 S. Broadway, White Plains, New York
Zeisig, Harry C., Jr.—Spencer Chemical Co.—Merriam, Kansas
Zilke, Sam—South Dakota State College—Botany Dept., College Station, Brookings, S. Dakota
Zinter, Clinton—F. H. Peavey & Co. 912 Grain Exchange, Minneapolis, Minnesota
Zorsch, C. P.—Monsanto Chemical Co.—Lindbergh & Olive St. Rd., Saint Louis, Mo.

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LIST OF MEMBER COMMERCIAL ORGANIZATIONS
as of December 31, 1957

AGSCO Chemicals, Inc.	Grand Forks, North Dakota
Allied Chemical & Dye Corporation	Edgewater, New Jersey
American Chemical Paint Company	Ambler, Pennsylvania
Atlas Powder Company	Wilmington, Delaware
W. H. Barber Company	Minneapolis, Minnesota
Brown Farm Chemical Company	Scottsbluff, Nebraska
California Packing Corporation	Rochelle, Illinois
Chemagro Corporation	New York 16, New York
Chipman Chemical Company, Inc.	Bound Brook, New Jersey
Chipman Chemicals Limited	Winnipeg 3, Manitoba, Canada
Clark Manufacturing Company	Atherton, Missouri
Columbia-Southern Chemical Corporation	Pittsburgh 22, Pennsylvania
The Davey Tree Expert Company	Kent, Ohio
Deere & Company	Moline, Illinois
Delavan Manufacturing Company	West Des Moines, Iowa
Diamond Alkali Company	Cleveland, Ohio
The Dow Chemical Company	Midland, Michigan
E. I. DuPont DeNemours & Company	Wilmington, Delaware
Fargo Foundry Company	Fargo, North Dakota
Farmrite Sprayer, Inc.	Juneau, Wisconsin
Farmers Union Central Exchange, Inc.	St. Paul 1, Minnesota
Flax Development Committee	Minneapolis, Minnesota
Food Machinery and Chemical Corporation	Lansing 4, Michigan
Geigy Agricultural Chemicals	Yonkers, New York
Hahn, Inc.	Evansville, Indiana
Hanson Equipment Company	Beloit, Wisconsin
The Hart Equipment Company	Rockton, Illinois
Heyden Newport Chemical Corporation	Garfield, New Jersey
Hooker Electrochemical Company	Niagara Falls, New York
H. D. Hudson Manufacturing Company	Chicago 11, Illinois
Illinois Farm Supply Company	Chicago, Illinois
Miller Chemical Company	Omaha 2, Nebraska
Monsanto Chemical Company	St. Louis 1, Missouri
Mutual Dealers Wholesale Inc.	St. Paul 14, Minnesota
National Aluminate Corporation	Chicago 38, Illinois
National Grain Company Limited	Winnipeg, Manitoba, Canada
Naugatuck Chemical Company	Chicago, Illinois
Northrup, King & Company	Minneapolis 13, Minnesota
Oberdorfer Foundries, Inc.	Syracuse, New York
F. H. Peavey & Company	Minneapolis 15, Minnesota
Private Brands, Inc.	Kansas City 18, Kansas
Reade Manufacturing Company, Inc.	Jersey City 2, New Jersey
Reasor-Hill Corporation	Jacksonville, Arkansas
Riverdale Chemical Company	Chicago Heights, Illinois
Sherwin-Williams Company Limited	Montreal, Quebec, Canada
Spraying Systems Company	Bellwood, Illinois
Standard Agricultural Chemicals, Inc.	Hoboken, New Jersey
Standard Oil Company (Indiana)	Chicago 80, Illinois
Stauffer Chemical Company	Omaha, Nebraska
Thompson Chemicals Corporation	St. Louis 3, Missouri
Thompson-Hayward Chemical Company	Kansas City, Missouri
Tri-State Milling Company	Rapid City, South Dakota
Tryco Manufacturing Company, Inc.	Decatur, Illinois
Union Carbide Chemical Company	New York 17, New York
United States Borax & Chemical Corporation	Los Angeles 5, California
Woodbury Chemical Company	St. Joseph, Missouri

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O		
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Weeds, Crops, and General Index (Continued)

Common name	Scientific name	
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Q		
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Smartweed, Pennsylvania	*Polygonum pennsylvanicum*	7
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Soybean	*Glycine max*	44
Spruce	*Picea* sp.	46, 50
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W		
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Wheat	*Triticum vulgare*	10, 40, 44
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Y		
Yew	*Taxus* sp.	27, 49

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Herbicide List and Index

The nomenclature of this list is based on the Report of the Terminology Committee of the Weed Society of America, in Weeds, 6:73, Jan., 1958. This list was not published in time to edit the text of the Proceedings to conform to it.

Names which begin with numerals are indexed as if spelled out: capitalization is indicated.

A

Alanap 1—NPA
Alanap 3—sodium salt of NPA
Amino triazole—amitrol
amitrol—3-amino-1,2,4-triazole 3, 9, 15, 19, 32, 50, 53, 56, 64
ATA—amitrol
Atlacide—trademark for a mixture containing 60% sodium chlorate 19

B

BDM—borate-2,4-D mixture 12, 19, 24
BMM—borate-monuron mixture 3, 13
BORASCU—trademark for crude, granular borate 12
borax—$Na_2B_4O_7$-$10H_2O$ 12

C

CBMM—chlorate-borate-monuron mixture 3, 13
CBM—chlorate-borate mixture 19
CDAA—2-chloro-N,N-diallylacetamide 6, 27, 42, 45, 46, 47, 49, 50, 53
CDEC—2-chloroallyl diethyldithiocarbamate 32, 44, 46, 50
Chlorazin—2-chloro-4,6-bis(diethylamino)-*s*-triazine 49
Chlorea—trademark for a CBMM 3, 13
CIPC—isopropyl N-(3-chlorophenyl)carbamate 45, 46, 48, 49
CMU—monuron .....
chlordane 30
Concentrated BORASCU—trademark for granular, high purity borate 12, 24
Crag Herbicide 1—sesone
Cyanamid—trademark for calcium cyanamide 30

D

dalapon—2,2-dichloropropionic acid 15, 25, 28, 31, 50, 53
DB Granular—trademark for a BDM
diuron—3-(3,4-dichlorophenyl)-1,1-dimethylurea 13, 32, 44, 46, 48, 50
DMA—disodium monomethylarsonate 30, 49
DMTT—3,5-dimethyltetrahydro-1,3-5,2H thiadiazine-2-thicne 49
DNBP—4,6-dinitro ortho-*sec*-butylphenol 44, 46
DSMA—DMA

E

Emid—trademark for 2,4-dichlorophenoxyacetamide 48
endothal—3,6-endoxohexahydrophthallic acid 32, 46
EPTC—ethyl-N,N-di-*n*-propylthiolcarbamate 4, 28, 30, 44, 46, 47, 49, 50
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G-30031—2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine 43, 44
G-30044—2-methoxy-4,6-bis-(ethylamino)-*s*-triazine 43
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H

HCA—hexachloroacetone 2, 3
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I

IPC—isopropyl-N-phenylcarbamate 6
IAA—indoleacetic acid 11

K

Karmex DW—trademark for diuron
Karmex W—trademark for monuron
KOCN—potassium cyanate 30, 49
Kuron—trademark for erbon

L

lead arsenate 30

M

Methar—trademark for crabgrass killer containing DMA
MCPA—2-methyl-4-chlorophenoxyacetic acid 3, 15, 25, 26, 40, 53, 55, 62
MH—maleic hydrazide 27
monuron—3(*p*-chlorophenyl)-1,1-dimethylurea 3, 13, 15, 24, 44, 45, 49, 50,
Mylone—trademark for DMTT

J

NAA—naphthalene acetic acid 39
Natrin—trademark for 2,4,5-TES
neburon—1-*n*-butyl-3-(3,4-dichlorophenyl)-1-methylurea 26, 30, 46, 48
NPA—N-1-naphthylphthlamic acid 30, 44, 45, 49, 50, 53

O

oils, petroleum 2, 15
1,2,4,5-tetrachlorobenzene 4, 37

P

PAX—trademark for crabgrass killer containing lead arsenate 30
PBA—mixtures of chlorinated benzoic acids, ranging from dichloro- to pentochloro- 4, 24, 32
phygon—2,3-dichloro-1,4-naphthoquinone 32
PMA—phenyl mercuric acetate 30
PMAS—trademark for crabgrass killer containing PMA
Polybor-chlorate—trademark for a CBM 19
polychlorobenzoic acids—PBA

R

Radapon—trademark for a dalapon formulation
Randox—trademark for CDAA

S

Sesin—trademark for sesone
sesone—sodium 2,4-dichlorophenoxyethyl sulphate 30, 45, 47, 48, 49, 50
silvex—2-(2,4,5-trichlorophenoxy)propionic acid 24, 32
simazin—2-chloro-4,6-bis-(ethylamino)-*s*-triazine 1, 2, 15, 19, 30, 31, 32, 43, 44, 45, 46, 47, 48, 49, 50, 56
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T

TCA—trichloroacetic acid 16, 31, 49, 57, 62
Telvar DW—trademark for diuron
Telvar W—trademark for monuron
3Y9—tris-(2,4-dichlorophenoxyethyl) phosphite 30, 47, 48
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U

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